for . . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

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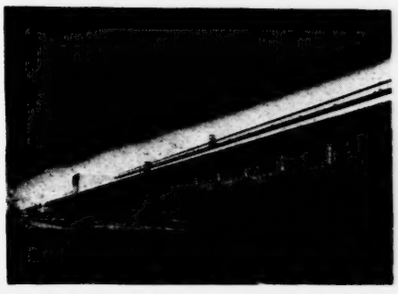

THIS MONTH'S COVER

This view shows about two-thirds of the long side of the main (manufacturing) building of the Ford Willow Run Bomber plant designed by the Office of Albert Kahn and described by one of the designers in an article beginning on page 25.

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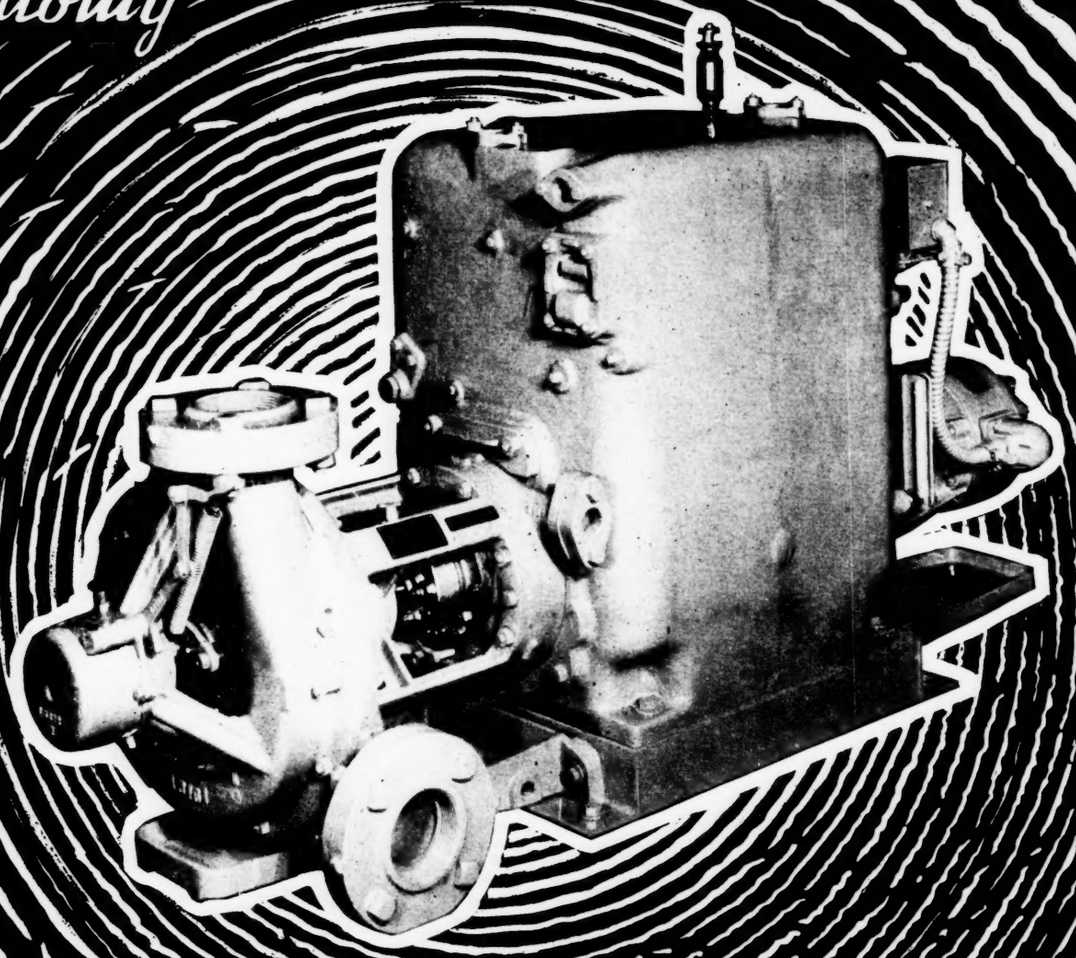
Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

The office building of Willow Run is shown at the left, while the engineering section of the main building is adjacent at the right.

Ford's Willow Run Bomber Plant,

now producing sub-assemblies for heavy bombers, is the largest plant in the world today. G. S. Whittaker, of Albert Kahn Associated Architects and Engineers, Inc., here describes the heating and air conditioning of this phenomenal 15 building project.

ONCE again Henry Ford has accomplished the impossible. Not much over a year and a half ago Ford Motor Company was asked by the Government to build complete heavy bombers. That was before Pearl Harbor; during the design and construction period the plant was redesigned several times until today, as the plant now stands, it occupies three times the area originally proposed.

The plant now is, and has been for some time, in operation, and has as its objective the manufacture, assembly, and testing of at least one complete Consolidated B24E four-motor bomber per day.

While it is not possible to publish detailed statistics it is sufficient to say that the plant is at present the largest known. In addition, there is a hangar building, a two-story office building, two-story personnel building, two-story training school building, and numerous other structures, including oil and gas storage building, dope and paint storage building, garage, commissary, dope shed, pump houses, scale house, power house, and other structures.

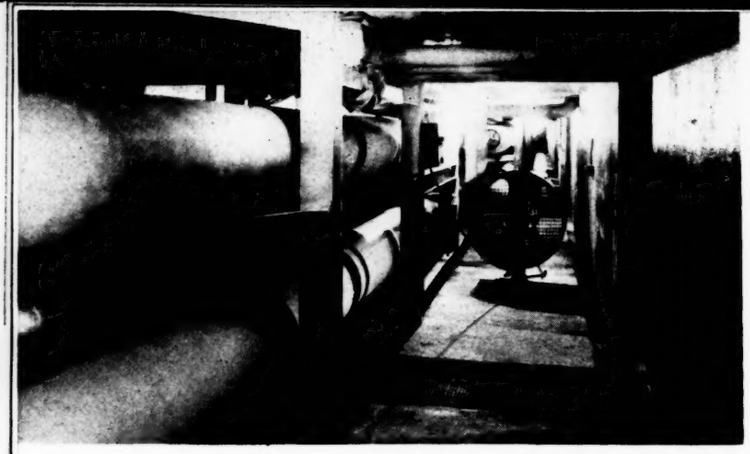
The principal building of course is the Main Assembly Building. Built of steel, face brick with back-up brick, gunite and steel sash, the Main Building is a semi-blackout one as there is no daylight in the production areas. The sash in the various exterior elevations are so placed as to provide light and ventilation for the respective factory offices and utilities which are located next to the outside walls on the first, mezzanine, and second floors. Production areas are of single-story construction, due to the immense height required for traveling cranes handling huge parts.

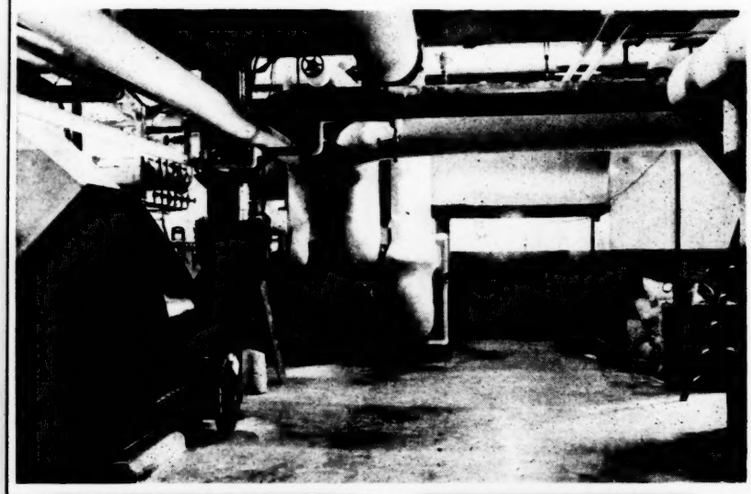
Completed ships leave this building under their own power and roll out on to a mile-square test field where they are test-flown. For landing and take-off, this field has six runways. Parallel runways cross the field diagonally in the direction of prevailing winds. Near the center is a paved area of concrete slab.

The major buildings comprising the project are heated from a central heating system served by steam from a central power house. The power house and the heating, ventilating and air conditioning of these major buildings will now be described.

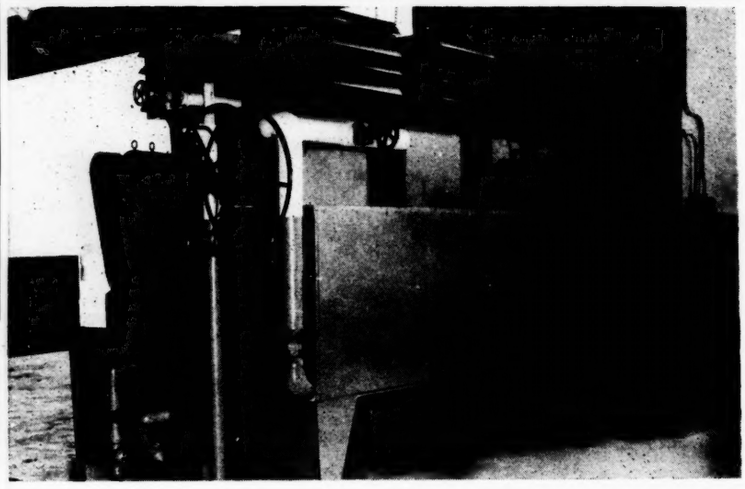
Power House

Steam is generated by oil-fired 4-drum bent-tube

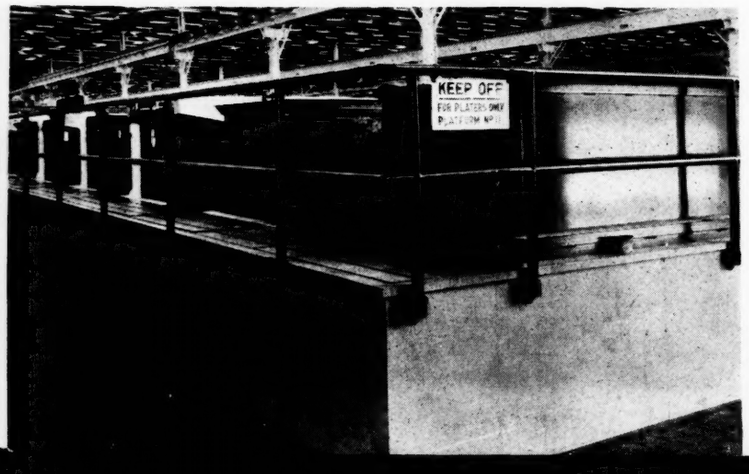




(Above) Main tunnel showing the main service lines, water, steam, compressed air and pump discharge, and so on. (Below) Office building machine room showing main lines running into the tunnel to the main building including the large chilled water lines. Also shown are water heaters, upper left, and supply fan in foreground.



(Above) One of the large floor type Trane Torridor unit heaters which blow along the floor across the large hangar doors in the hangar building.
(Below) Plating tanks in the manufacturing area of the main building. Ncte the third tank where ducts along the side of the tank exhaust acid fumes.



boilers, each having a capacity of 80,000 lb of steam per hour and operating at 250 lb gauge pressure, superheated to 438F.

The Power House and boilers are designed so that they can be converted into handling, storing and burning coal with stokers if needed later.

The 2,500 kw turbo-generators can be operated either condensing or extracting. Ninety thousand pounds of steam per hour per turbine is extracted at 50 lb gauge pressure and used in the heating system, domestic hot water heating and process steam for factories. Additional steam for peak loads is made up from live steam through pressure reducing stations located in the Power House and at different points throughout the factory.

Cooling water for the surface condensers is supplied from a nine section induced draft cooling tower located in the rear of the Power House.

Condensate from the factory heating and process systems is pumped back to a main condensate and make-up receiver located above the deaerating feed water heater in the Power House. From this receiver it flows by gravity to the deaerating feed water heater, where all feed water is heated to 227F using exhaust steam from the steam driven auxiliaries.

The boiler feed pumps take suction from the feed water heater and discharge to each boiler feed nozzle, through an economizer at each boiler.

Steam Distribution

A 12 in. high pressure steam line runs through a tunnel to the Main Building to serve the process equipment. This main is also cross connected with the heating system to build up the pressure at the end of heating system mains in the tunnel.

These heating system steam mains are supplied with 50 lb steam exhausted from the air compressors and engines as described under Power House.

The Power House is located at a distance from the Main Building, so that an 18 in. line is run in a tunnel directly to the building and under it to about the center, where it branches to serve the Training School, Office and Hangar Building.

About every 200 ft along this tunnel there is a wing about 4 ft square in area to accommodate the branch piping as it is taken off to serve the various sections of the building.

Condensate Return

All the condensate returns from the various systems and process equipment run to pump and receiver units in Pump Rooms located in strategic points in the Main Building, as well as in the various small buildings in the vicinity around the Main Building. There are Pump Rooms in the Main Building, in the Hangar and in each of the other buildings. All these condensate pumps discharge to a return main in the tunnel which runs back to a large receiver in the Power House about 75 ft above the first floor level. The heads of these pumps vary from 175 ft to 200 ft, depending on their location in

relation to the Power House. Incidentally, these units are all duplex units, and the pumps are of the turbine type, well fitted for comparatively small loads and high heads.

Main Building

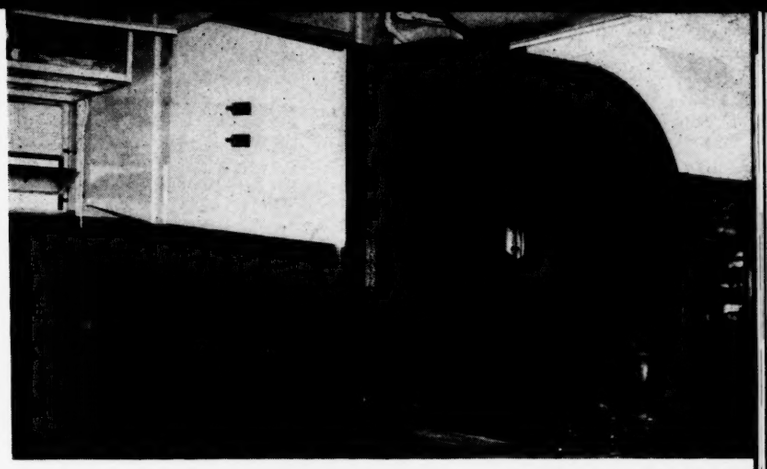
This building is largely one-story construction with long mezzanines running practically the full length of the building and with Office and Engineering Sections running across the width of the west end of the building. This section also houses the Hospital Ward, Doctors' Offices and Operating Rooms, all complete in every detail.

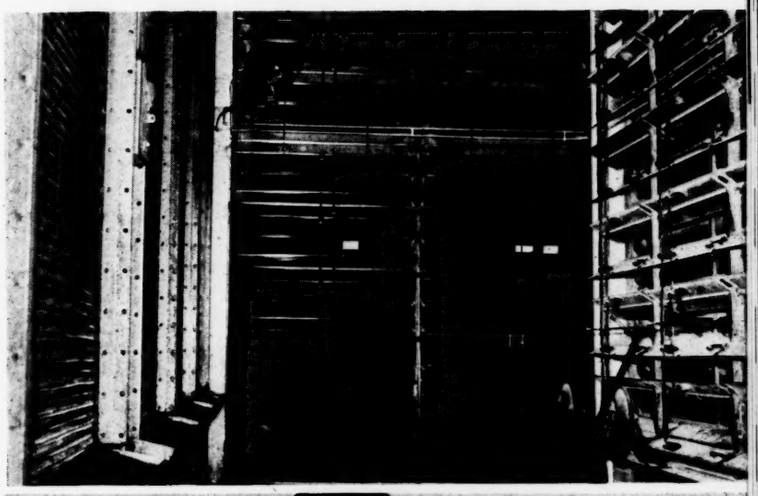
After much deliberation and study of the various types of heating systems and the conditions to be met in the building, it was decided by the Ford Motor Company and the engineers to use a hot blast system in the factory portion and a combined hot blast system and direct radiator system in the Engineering Section. Due to the fact that the Main Building is broken up by the mezzanines, the hot blast system had to be broken up into sixty-nine fan rooms, located in some cases above the roof and in other cases on the second mezzanine. These fans vary in size from those handling 35,000 cfm to those supplying 100,000 cfm, depending on the area covered. All of these fans have two-speed motors.

The fans supplying hot air in winter are also used in summer to bring large quantities of outside air into the building so as to create an air movement for comfort. This air is subsequently removed from the building by (1) process exhaust ventilation, (2) by roof ventilator fans of 10,000 cfm capacity each, and (3) recirculation to the supply fans. This system creates quite an air turnover equivalent to approximately four air changes per hour for the entire height of the building or ten changes at a 12 ft height—the working zone.

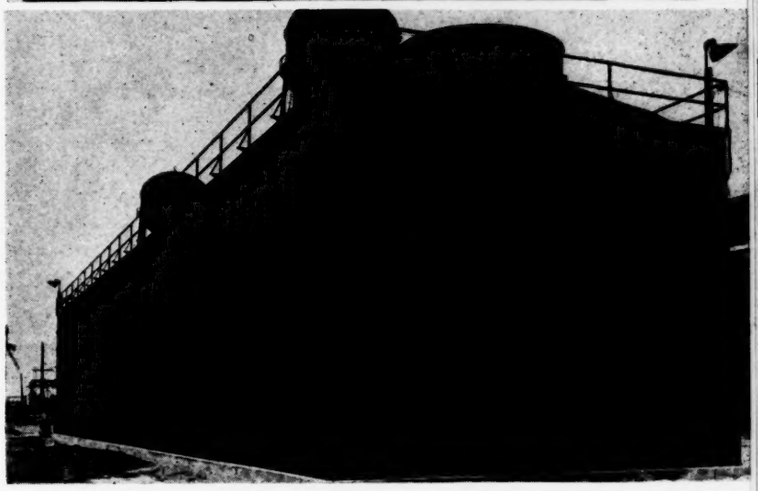
Warm air from the hot blast system is distributed through a system of duct work located in the truss space. These ducts fan out in all directions with outlets spaced at regular intervals properly to distribute the air to the working area. Where there are mezzanines, branch ducts drop down at the columns to distribute the air to the lower levels. Although the ducts in the trusses are quite large in some cases, it is surprising how inconspicuous they are in the finished job.

It is obvious that to introduce as much outside air in the winter as is done in the summer would impose a tremendous load on the steam generating and distributing system. Also, while it is desirable to move as much air as possible in the summer for comfort, in the winter it is essential to move only a sufficient amount to keep the air circulating slowly over the entire area so as to distribute the heated air. With this in mind, the motors are all of the two-speed type, using the low speed in the wintertime, so as to give approximately two air changes per hour for the total height of the building. However, even so, if all this air were outside air, the steam load would be very large and considerably





(Above) A view of a part of one of the main fan rooms, showing the New York Blower fan and G.E. motor. (Below) Inside view of the intake chamber of one of the main fan rooms showing the Minneapolis-Honeywell damper motors and dampers and the back of the tempering coils.



(Above) The large Water Cooling Equipment Co. cooling tower near the power house, which takes care of the condenser water for the power plant. (Below) The second floor drafting room in the engineering section, heated by convectors and air conditioned in the summer.

East side of the hangar building. Note the large doors and, in the center, the control tower, the nerve center of the flying field.

higher than the heat load of the building warrants. Consequently, enough air is recirculated in the wintertime to keep the intake chamber no lower than 35F, with enough coil surface provided to raise the air to 95F if necessary. This temperature is governed by thermostats which control modulating steam valves in the supply lines to keep the building from overheating while supplying the maximum amount of air at all times. The steam load is thus approximately what it should be in relation to the building heat loss and there is one complete change of outside air in cold weather. Incidentally, all the coils in these fan units are of the non-freeze type, supplied with steam at approximately 30 lb pressure, assuring no freezing at any time.

There are also various small fan units scattered throughout the buildings to serve isolated areas such as First Aid Rooms, Gauge Room, Inspection Departments, which required the maintenance of special temperatures.

Overhead unit heaters are located at all the outside doors as well as along the ends of the building where there are very large glass exposures. These heaters, all thermostatically controlled, allow the air to be introduced at approximately the same temperature all over the building.

Steam and return mains which serve the fan coils and heaters run in the trusses to the various units. The steam mains are fed from five 10 in. risers which connect to the 50 lb steam main in the tunnel where they are all controlled by sectional shut off valves.

The two-story Engineering Section along the west side of the building is heated by direct radiators along the outside walls under the windows. In the Offices, Operating Rooms, Laboratories and Hospital Wards, the radiators are wall-hung convectors with sloping grilles in the top, while the radiators in the Toilet Rooms, Locker Rooms and Stair Halls are all wall-hung cast iron. All of the radiators and convectors are supplied by low pressure steam supply and return mains run in a 4 ft square trench which runs along the entire length of the Office section. The steam in this section is divided into four branches to allow zoning.

There is a completely equipped hospital unit in this area, including a highly modern operating room complete with operating table, instruments, sterilizers and blanket warmers. All the sterilizers and other steam-using equipment are recessed with only the ends of the units and the valves exposed in the room. The contractor, in order to have these tappings and openings located exactly to suit the equipment, made a large wooden template with all the tappings marked to agree with the manufacturer's drawings. This template was set up where tile was to be installed in the finished job and the valves and fittings placed accurately according to the template. When this work was all done, the template was removed and the tile and wall equipment put in place, making a splendid piece of work.

There is a complete kitchen and dining room in the Engineering Section, and all of the steam-using equipment there is supplied with 30 lb steam the year round.

Certain areas in the Main Building are treated somewhat differently than the rest of the building—the Dope Shed and the large Spray Booths.

The Dope Shed is required to be kept at a certain temperature and humidity the year round. This is necessary to maintain the proper tautness in the fabric on the wings, and also to prevent "blushing," a defect causing waves or wrinkles in the fabric. To meet these conditions, the Shed is heated by a combination of warm air and radiators. It has its own blast system controlled locally, with air supplied through two large fans connected to coils, air washers and filters; air is also supplied by several overhead unit heaters. The radiators are set along the side walls under the windows and are installed primarily to prevent window sweating, since a high humidity is maintained in the room. This system was worked out by the Ford Motor Company engineers and plans were drawn under their directions to suit the operations carried on in the room.

There is a self-contained air conditioning unit in this area for summer use. A cooling tower is located on the roof above this building to serve the air conditioning units as well as one in the hangar.

There are two large Spray Booths in the east end of the building where the planes are given their final coat of paint. On a project as big as this, there is naturally a large volume of air exhausted from the Spray Booths. This air must be replaced if comfortable working conditions are to be maintained. This was accomplished by large supply fans and heaters located on the roof of the booths which draw air from the factory space (where it is supplied by the large supply fans) and reheat it to the required temperature for good painting practice. These fans, of which there are four, handle approximately 40,000 cfm each, with sufficient blast coil surface to raise the air temperature from 60 to 100F.

Air from the booths is exhausted downward through a water wash at the side of the booths

A view of the manufacturing area of the main building.

where the paint is washed out of the air before it is discharged to the atmosphere. This paint is then reclaimed from the water through settling basins and re-used after a purifying process.

A large number of underground transformer rooms in the building, as well as inside toilet and lunch rooms, had to be heavily ventilated to maintain healthy conditions in these areas. All these rooms have a complete system of exhaust ventilation with the fans in fan rooms in the trusses.

In one section of the manufacturing area, a cyanide process is used in connection with certain tank processes. The fumes from this area are quite dangerous, so that an extensive exhaust system was devised to meet the conditions. The air is drawn down into underground vent ducts which carry the air to large rubber-lined fans specially constructed for this work. These fans are located in underground fan rooms and discharge the air up through ducts lined with a heat and acid resisting paint to a point considerably higher than the roof. Consequently, the fumes are released to the atmosphere far enough above the building to allow for their safe dissipation. This underground duct is made of a ceramic material with sealed joints between the tanks and the fans, and has proved highly satisfactory. There are a total of eleven of the fan units, all located in the same area of the building.

There are a few small areas under the mezzanine, along the north wall, closed in to serve as gauge rooms, inspection rooms, and such uses. These are heated and cooled by small self-contained air conditioning units complete with duct work and outlets with a small refrigerating unit set on the floor. These rooms are maintained at constant temperature the year round.

All the truck wells, the large shipping area and the receiving area in the Main Building are heated by overhead vertical type unit heaters, except at the large doors where blower type units are used. These heaters all have 3-position starters and thermostats, one of each for each heater.

Office Building

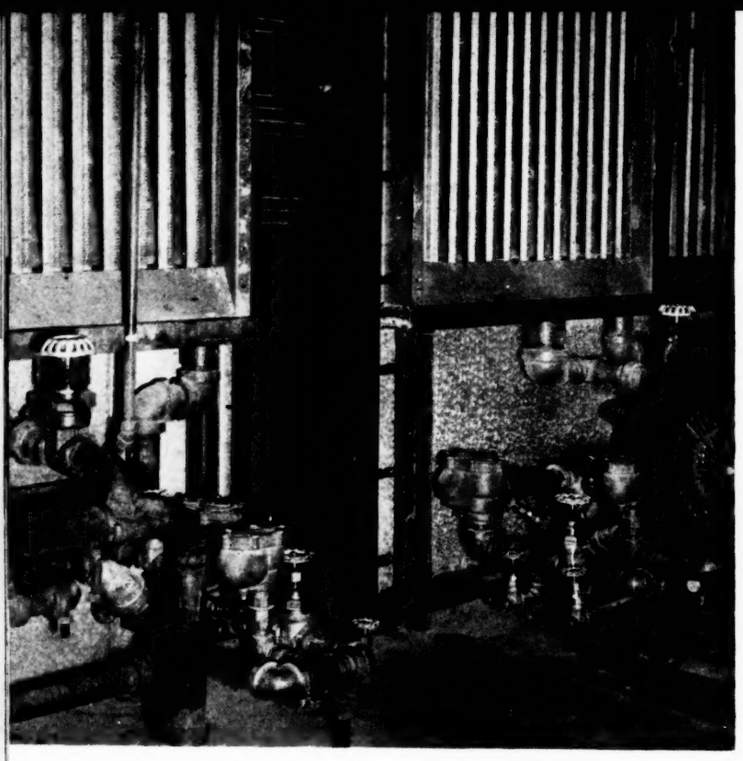
This structure is a two-story building with part basement consisting of a fan room and machine room, in which is housed the air conditioning equipment for the Office and Engineering Section in the Main Building.

Although this building is completely air conditioned, summer and winter, since it has a rather large proportion of window area, it was thought necessary to have radiators under the windows in all the rooms. This meant that a fairly close system of control would have to be maintained on both the direct radiators, whatever kind of system was to be used, and on the blast coils also. After considerable discussion it was decided to install a hot water system to supply the radiators and steam for the fan coils. It was felt that a closer temperature in the room could be attained with this combination, as the hot water can be controlled at a low temperature. Also, by using a hot water system, both the supply and return mains could be placed in the pipe space above the second floor ceiling, which makes a clean piping job in all ways.

An additional floor has been designed for but not installed in this building. This raised the question of radiator surface on the second floor. If sufficient surface were installed to take care of the roof heat loss, the floor would be over-radiated when the future floor is added, and the system would be unbalanced. To provide for this, the same amount of radiator surface was installed on the second floor as on the first; then, to take care of the roof loss, the mains and branches in the pipe space were left uncovered, resulting in heat emission which balanced the required heat loss. In the future, if the extra floor is added, the mains can be covered.

Since this building faces west, and with the long walls facing east and west, the sun heat gain is substantial. This would result in different temperatures on each side of the building, with a high temperature on the west side in the afternoon and on the east in the morning. To offset this, both the air conditioning and the hot water heating systems are divided into zones, four zones on the ventilating and two zones on the radiation.

Each zone on the heating system has its own heat exchanger and circulating pump, with a standby pump and heater available in case of a breakdown. These heaters are controlled by a Weatherstat control system, with outside bulb, three-way valve and switches, etc. Air is introduced into the rooms of each zone at approximately room temperature at all times, and each zone heating coil is supplied with steam at 5 lb pressure and is controlled by a duct stat and thermostatic valve. This means that the heat loss through the walls, windows, and so on, is compensated for by the radiators by varying the water temperature with the three-way valves. The water in the heaters is maintained at 200F temperature at all times by an immersion-type aquastat and a thermostatic valve on the steam line. As the water



Rear view of the Trane non-freeze coils in one of the main fan rooms of the manufacturing building, showing the coils, by-pass dampers, and steam and return piping before it is covered.

circulates through the system, some of it by-passes the heater until the outside bulb calls for heat when the three-way valve partly closes and runs some of the water through the heater, mixing the 200F water with the water circulating through the system until the radiators have brought the room temperature up to requirements; then the three-way valve will again partly close and by-pass more of the water around the heater.

The compressors for cooling this building (two 400 ton machines) and the Engineering Section of the Main Building are located in the basement where water is chilled, then circulated through the water coils in each fan room. Water required for the condensers is pumped over from this building to a cooling tower at the southwest corner of the Manfacturing Building and thence back.

The private garage for the officers, which is located between the Main Building and the Office, is heated by a hot blast system with blower type heaters at the doors thermostatically controlled. All of this equipment is supplied with 30 lb steam; the return lines run to the receiver in the Office Building.

Hangar Building

The Hangar consists of hangar space, repair shops, ambulance garages, and central control section which houses the field operations quarters, etc., as well as bedrooms, kitchen and dining room for the incoming and outgoing pilots. The building is heated by a system of unit heaters in all the hangar and repair space, with the center section completely air conditioned and with radiation on a hot water system at the outside walls.

Most of the unit heaters are of the overhead, down-blow type supplied with steam at 30 lb pressure and the returns run by gravity to two pump and receiver sets in pump rooms in the two-story portion at the rear of the building.

Large doors in the side of the building facing the flying field created quite a heating problem, as it takes approximately two minutes to open or close them; this gives the wind a fine opportunity to rush into the immense hangar space. To combat this, very large blower type heaters were placed on the floor at each side of the doors and vertical overhead heaters immediately above them. These heaters provide a curtain of hot air which, it is expected, will be entirely satisfactory. The floor-type heaters are supplied with steam at 90 lb pressure, and the condensate is discharged back up into the trusses (approximately 45 ft) and over to the receivers in the pump room.

The center section is completely air conditioned by equipment in two fan rooms. The two systems are zoned to suit the exposures and can be controlled to suit any conditions in any area. The compressors for this section are located in the machine room on the fourth floor.

Radiators are employed along the east and west walls, the only walls with outside exposure except the fifth floor which has exposure on all sides. These radiators are connected to a hot water heating system with both mains above the fourth floor ceiling feeding down to the radiators on the lower floors and up to the radiators on the fifth floor. The radiators are of the same type as those in the Office Building. The hot water system has two water heaters and two circulating pumps, one set of which is a spare unit. The system is controlled by a hot water compensating control with an inside and outside bulb controlling a valve in the steam line to the heater. These bulbs have a differential setting of 200F; when the outside temperature is zero the water temperature required is 200F, and as the outside temperature rises, for example, to 30F, the water temperature drops to 170F, and so on.

On the roof of the center section is the Control Tower of the Flying Feld, the nerve center of this

A view of the assembly line. The heating and ventilating ducts are located in the trusses.

Close-up of an American viscous filter in the air conditioning system.

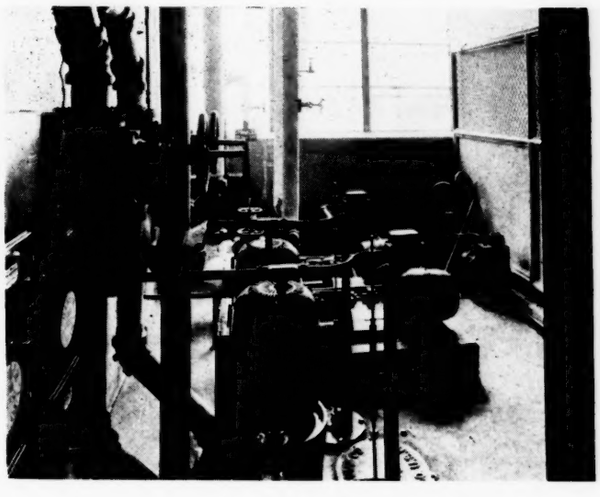
whole area. From this point all the detailed operations of the field are run and, therefore, it is imperative that the windows of this 20 ft. square room are kept free of ice, or fog. Consequently, a dual system of steam radiation and air distribution was provided. There is a special fan supplying heated air to this room through a very narrow slot along the window at a high velocity at whatever air temperature is required to keep the windows free of frost or fog. Enough air is introduced at lower temperatures at other places to keep the temperature of the room at a normal heating temperature. There are also four radiators located one on each side of the room, all thermostatically-controlled, to add any extra heat needed for very severe weather, or to keep the room heated whenever it is not in use over an extended period.

The kitchen equipment and water heaters are on a 30 lb steam line which is on the year round. The steam services for this building, as well as the pump discharge line, are connected to the main tunnel, as is the Assembly Building.

Training School

This building is a two-story structure and is identical with the Office Building as far as construction is concerned. The heating and the ventilating systems are very much the same as the Office Building, including zoning on the fan system and with the heating system split into north and south zones with heater and pump, three-way valves, etc., on each zone, and with a spare heater and pump.

This building is a complete school for the apprentices, including work rooms, class rooms, repair shops, laboratories, etc. The water, steam, pump discharge and compressed air services come from the main tunnel.



A typical pump room in the main building showing the two condensate pumps and the two large ejector pumps.

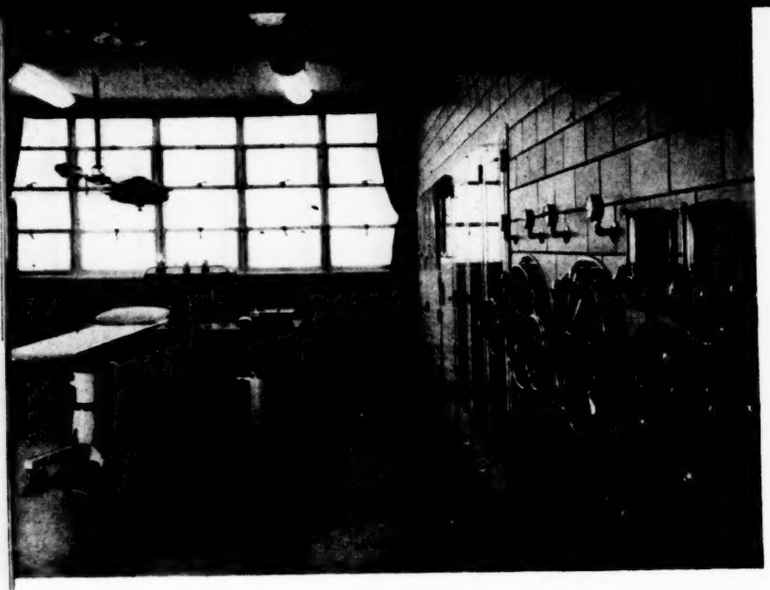
Personnel Building

The Personnel Building is a two-story structure with part basement situated a considerable distance from the main plant. Here all the new applicants for work are first interviewed; also the plant police have their headquarters here.

This building is heated by a two-pipe gravity steam system with wall-hung convectors in all the main portion of the building and cast thin-tube wall-hung radiators in the toilet rooms and stair halls. The building is ventilated with supply and return air systems. The fans are located in a fan room on the roof, and the air is distributed from these fans through a system of ducts to all parts of the building. This system is zoned for complete control the same as the heating system. The supply and return lines run on the basement ceiling feeding up to the radiators on the first and second floors and to the roof. Steam and pump discharge lines are run underground in pre-sealed underground conduit with welded ends from the north end of the main tunnel to this building, approximately 1,000 ft. The expansion in these lines is taken care of by means of pipe bends, located about 250 ft apart, in special concrete manholes which are kept dry by floor drains connected to the underground drainage lines. Anchors are provided between the bends, and these consist of blocks of concrete around the pipe and of sufficient width to insure perfect anchorage.

The heating system is divided into four separate zones which are controlled by motor-operated valves and thermostats located in each zone. Each radiator has an orifice plate to insure better and more even distribution of the steam.

The water heater is supplied directly from the 30 lb steam service while the blast coils and the steam lines to the radiator system are supplied from the 30 lb steam service main through a pressure reducing valve located in the basement machine room. The condensate from radiators, blast coils, etc., runs by gravity to a duplex pump and receiver unit located



Operating room in the hospital. Note the Trane wall-hung convectors and Air Devices outlet. The apparatus on the wall at the right includes the various sterilizers, blanket warmers, and so on. See text referring to the unusual installation of this equipment.

in the basement machine room, and the pump discharge runs to the Main Building.

Oil and Gas House
Dope and Paint Storage Building

These two buildings, of one-story construction with a small mezzanine at one end for fan rooms and storage areas, are heated by overhead duct systems supplied by a number of heating units which take in outside air and use steam at 30 lb pressure. The toilet rooms, pump rooms and locker rooms which occupy small space are heated by direct radiation from a 5 lb steam line.

The air is exhausted from the building by roof ventilators with motor driven fans which have a capacity of 10,000 cfm each.

The steam and pump discharge lines supplying these buildings are brought underground from the Main Building through pre-sealed conduit, so that expansion bends were not necessary. This steam service is at 30 lb, the same as the other buildings, and there is a duplex pump and receiver set in the machine room.

Garage

Of one-story construction with a part mezzanine, the garage is used for the repair of all the large and small trucks essential to a plant of this size. All manner of repair is done in this building, including painting, and also there is a complete wash rack with air dryer and power washer.

This building has a few special features in its heating and ventilating systems to take care of some of these services.

Steam from the Power House enters the building through the small basement machine room where are located the water heaters for the wash rack and the domestic system. From this 30 lb line a branch is run to the first floor, where it is run around to serve the unit heaters in the various departments. There is a branch from the main 30 lb line in the basement which is reduced to 5 lb for supplying the radiators and blast coils. All the returns run back by gravity to the duplex pump and receiver in the basement from where it is pumped back to the Power House.

The Garage proper is heated by wall-type radiators located under the windows along the outside walls and a blower type unit heater at the main entrance door.

The locker rooms, offices and tool room are heated by either wall radiators or thin-tube radiators, wall-hung, with the returns running along the wall under the radiators to the receiver in the basement. The paint spray room is heated by a unit which takes in all outside air, heats and filters it, and maintains a temperature of 80F. The air is exhausted by means of the exhaust fans in the Spray Booth.

There are exhaust fans in the roof over the wash rack and two in the wall of the garage proper for exhausting carbon monoxide fumes from the floor. Makeup air is supplied from a winter supply unit located on the roof of the Garage. This unit takes in outside air through a blackout-type head on the roof, then through a heating coil with face by-pass dampers before being discharged into the room by a centrifugal fan. There is an intake damper which automatically closes by a spring return damper motor, whenever the fan itself is stopped. The face and by-pass dampers are controlled by a modulating type thermostat. There is also a blower which takes in air from the building and discharges it by means of flexible hoses along the car after it is washed to facilitate drying it.

Commissary

This building, one story with a mezzanine office section along part of the front section, is used for preparing the box lunches for the workers in the plant, and the food is distributed by means of wagons which are wheeled to their respective stations in time for the lunch period.

The 30 lb steam and pump discharge lines enter the building through a service pit in the rear of the building from an underground conduit. Branches are run to the unit heaters, soup kettles, steam coils in the steam room and bottle washers. The steam is reduced through a pressure-reducing valve station to 5 lb to serve the radiators and blast coils. A supply fan and blast coils in the fan room on the roof supply heated and filtered air to the

WILLOW RUN

This Project designed by Ford Motor Company engineers and the Office of Albert Kahn Associated Architects and Engineers, Inc., in close collaboration.

Boiler room interior showing Wickes boilers fired by Peabody oil burners, with gauge board on the left.

office section on the mezzanine during the winter.

The building is heated by direct radiation supplied with steam at 5 lb pressure in the small rooms and the office section, while the center or wagon section is heated by overhead unit heaters supplied with steam at 30 lb pressure.

There are about fifteen large soup kettles and three very large coffee urns in one room heated from the 30 lb line. There also is a steam room in which the coffee is heated before being delivered to the men in the factory. The coffee is first made in the large urns, is then bottled and placed in wooden cases, twenty-four to a case. These cases are placed in the steam room and heated to 180F and are taken out just before being delivered to the men for lunch, and by the time they arrive at their destination, by wagon, they have cooled to just the right temperature for drinking.

There is a perforated steel floor in this room under which is a steam coil consisting of three lengths of 1½ in. pipe, perforated every 8 inches with a ⅛ in. hole in the top of the pipe. When the steam room is operating, the steam for these coils is turned on from outside the room, liberating steam into the room and heating the coffee rapidly, as it wets the surface of the bottles and gives it a higher heat transmission. In addition, the steam keeps the wooden cases damp and extends their life. They would become very dry in a 180F temperature and tend to fall apart if they were not wetted by the steam vapor.

Air in this steam room is heated by pipe coils along the walls controlled by a thermostat and thermostatic valve. This stat hangs on the wall outside the room with the bulb running through the wall into the room so that the temperature can be varied from the outside without opening the door.

All the condensate from the various systems is run back to a duplex pump and receiver set located in a pump pit before being pumped back to the Power House.

Miscellaneous

The Scale House and Fire Pump House are both heated by small direct-fired oil-burning warm air furnaces of the type used in residence work. They have all the necessary duct work, burners, oil tanks and controls for a complete heating job, and they are heated in this manner because of their location, which is distant from the central system.

All the small guard houses along the property line and other small buildings are heated by small electric radiators hung on the walls.

Summing up, there is a total of approximately 580 fans in the main building including supply fans, exhaust fans and roof ventilators, and approximately a hundred unit heaters—a total which gives some idea of the size of the building.

Contractors for Willow Run

General Contractor: Bryant & Detwiler Company, Detroit; Heating and Plumbing Contractor: Donald Miller Co., Detroit; Air Duct Contractor: Carlson Bros. of Michigan, Inc., Detroit; Power House Contractor: Wickes Boiler Co., Detroit.

Administration of Construction

For Ford Motor Company, H. B. Hanson, Chief, Power and Construction Division, Ford Motor Company; for the Office of Albert Kahn Associated Architects and Engineers, Inc., George Scrymgeour and Raymond C. Bernardi; for Defense Plant Corporation: Robert H. Dailey; for Bryant & Detwiler Co.: Charles M. Reik and John G. Campbell.

PARTIAL LIST OF EQUIPMENT SUPPLIERS

Armstrong Machine Works.....Steam Traps
Illinois Engineering Co.....Steam Traps
The Trane Co.....Unit Heaters, Fans, Convectors
Sarco Co., Inc. ..... Traps and Control Valves
Foxboro Co. .....Gauge Board and Instruments
Powers Regulator Co.....Temperature Control Valves
Buffalo Forge Co.....Fans
American Blower Co.....Unit Heaters and Coils
Chicago Pump Company.....Condensate Units
Modine Mfg. Co. .....Convectors
C. A. Dunham Co. .....Radiator Valves and Traps
U. S. Radiator Corp. .....Cast Iron Radiators
The Fulton Sylphon Co. .....Expansion Joints
Yarnall Waring Co. .... Expansion Joints and Strainers
Fisher Governor Co. .....Strainers
E. B. Badger & Sons Co. .....Expansion Joints
Minneapolis-Honeywell Regulator Co. ..... Controls
S. T. Johnson Co. .....Oil Burners
Bell & Gossett Co. .....Hot Water Specialties
Taylor Forge & Pipe Works .....Welding Fittings
Tube Turns, Inc. .....Welding Fittings
American-Marsh Pumps, Inc. .....Condensate Pumps
Johns-Manville.....Pipe Insulation
Ric-wil Company.....Presealed Underground Piping
Detroit Lubricator Co. .....Radiator Valves
Aerofin Corp. .....Heating Coils
New York Blower Co. .....Fans
Staynew Fitter Co. .....Air Filters
Midwest Piping & Supply Co., Inc. ....Welding Fittings
Crane Co. .....Valves
American Air Filter Co., Inc. .....Air Filters
Carrier Corp. .....Air Conditioning Machinery
Westinghouse Elect. & Mfg. Co., Air Conditioning Mach'y
Airtemp Div., Chrysler Corp. .. Air Conditioning Mach'y

Fig. 1. Lower portal of Salt Lake County Tunnel at Bingham, Utah. Tunnel traffic is regulated by automatic signal lights. The raised sidewalk is for pedestrians.

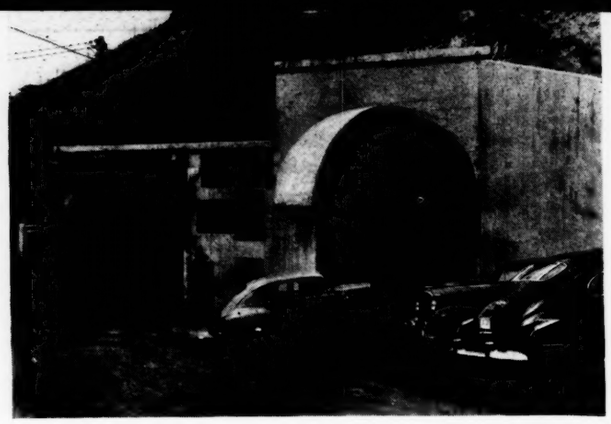


Fig. 2. Upper portal of the tunnel showing the ventilating fan opening at the right. The overhead roll door over the main tunnel operates automatically with the fan.

Electronic Control for Tunnel Air and Traffic

A SERIES of electronic relays, or electric eyes, successfully control vehicle traffic and ventilation in a tunnel 6,000 ft long, through a mountain at Bingham, Utah, handling about 600 cars per day.

This tunnel was constructed when expansion of the great Utah Copper Company's open cut Bingham mine made it desirable for Salt Lake County to abandon the county highway, which ran across the ore body, where excavating operations at the mine made serious hazards for vehicular traffic along the highway.

At first officials thought it would be necessary to make the tunnel wide enough for a two-lane highway, which would have been a very expensive project. Instead the General Electric Company was called upon to design an automatic control system which would operate upon the following cycle: (1) prohibit all vehicles from entering the tunnel until it was clear of traffic; (2) allow traffic to enter only at one end for three minutes; (3) reverse the flow and permit traffic to enter only at the opposite end for three minutes; and (4) repeat the cycle.

This is accomplished by means of photo-electric relays which actuate the stop and go signal lights at each end of the tunnel. Fig. 1 shows the signalling system at the lower end of the tunnel. The signal group at the right has one green light and three red ones. Two of the red lights are in multiple to give protection against one of them burning out, while the third red light is connected through a throw-over relay to a battery in order to stop traffic in case of a power failure. The signal at the left has one green and one red light, and is there for the convenience of drivers who are so close to the tunnel entrance that they have trouble seeing the lights at the right, which are higher overhead.

Fig. 2 shows the signal lights at the upper end of the tunnel, also the automatically-operated overhead roll door and ventilating fan, which operate when the concentration of carbon monoxide exceeds a certain limit. Fig. 3 shows the electric eye installation in the tunnel wall.

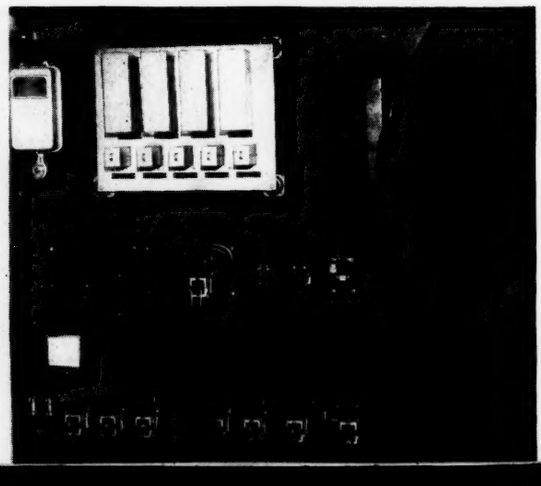
If the carbon monoxide content of the air in the tunnel rises above a predetermined percentage, the control system indicates this fact, at the same time automatically starting a ventilating fan which continues to run until the carbon monoxide content in the tunnel air falls below the safe percentage. Also, if a vehicle lags in the tunnel and the outgoing count falls below the ingoing count, this fact is signalled and a patrolman who stays within hearing of the alarm bell rides through the tunnel to shoo out the laggard. The ventilation system works automatically with the counting and signalling. The patrolman has to re-set the system manually following the alarm.

The upper end of the tunnel is approximately 350 ft higher than the lower end, making about a six per cent grade. During most of the year the chimney effect is such that it ventilates itself, so that the fan runs only in case of dense traffic.

When the automatic controls were first placed in service, mischievous boys would place a board in front of the photo-electric relays to give extra counts, thus tying up traffic. A few hours in the Bingham jail for the culprits soon eliminated this nuisance.

Fig. 3. Interior of tunnel. The rectangular box shown in the wall contains the electric eye mechanism for counting the cars.

Fig. 4. Main control panel, located in room at the lower portal. Beside it is County Electrician Carlquist, who is responsible for maintenance.



A MUST ARTICLE FOR EVERY HEATING MAN

A MILLION TONS OF SCRAP FROM RADIATORS!

The author explains how it is practicable to obtain at least a million tons of scrap iron and steel per year by replacing old pipe coils and radiators by unit heaters and convectors. He shows that the net yield is extraordinarily high, and indicates a way in which the heating industry can make an important contribution to the war effort. Mr. Dixon is chairman, committee on conservation, Industrial Unit Heater Association.

By A. G. DIXON
Manager, Heating Division,
Modine Manufacturing Company

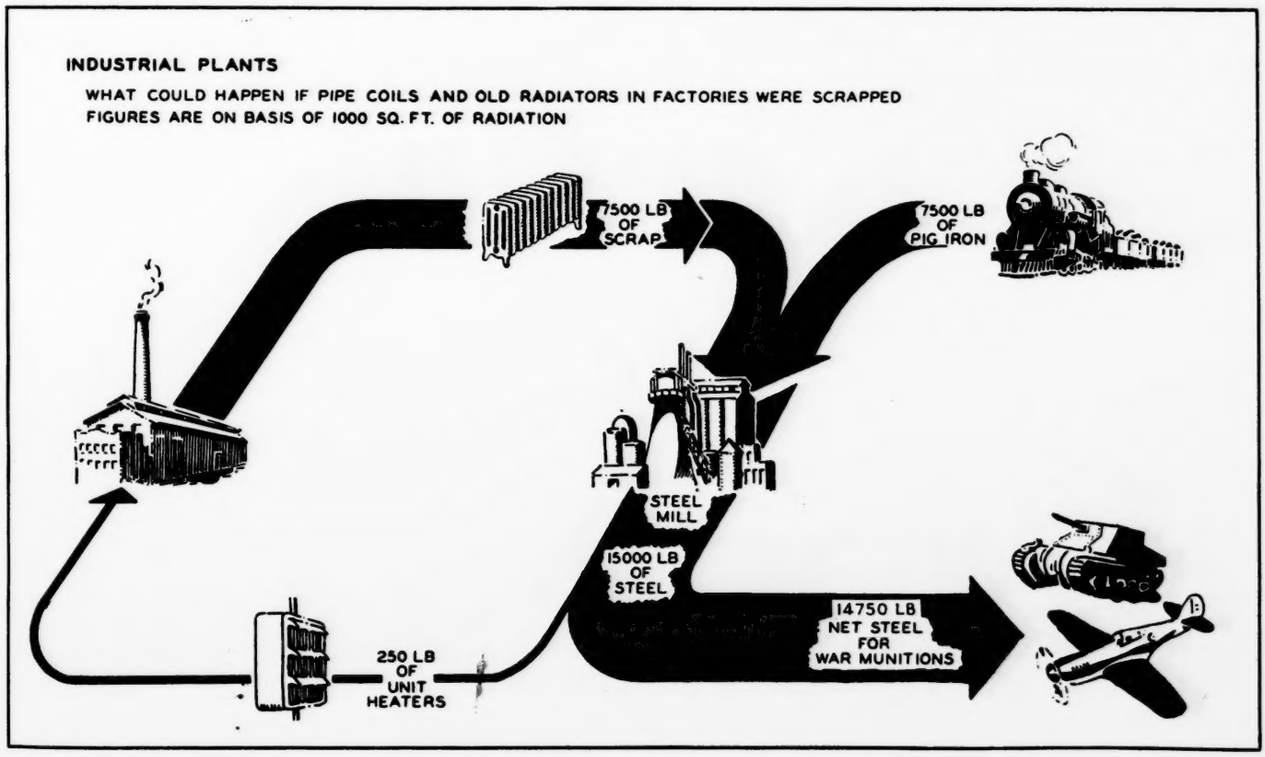
AT least one million tons of scrap iron and steel per year can, according to a fair estimate, be recovered from U. S. factories and other buildings by replacing existing pipe coils and old cast iron radiators by unit heaters and other steel extended surface equipment.

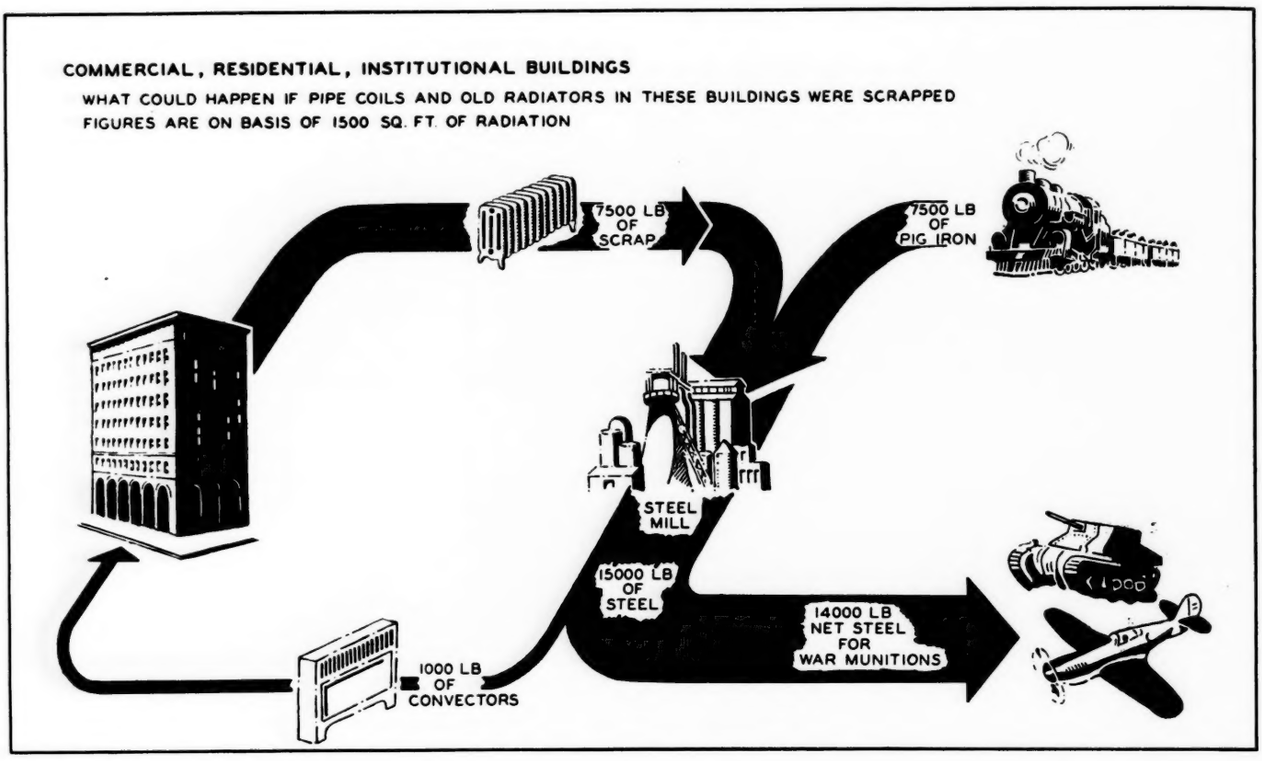
Need for Scrap

Steel mills of this country are working at their ultimate capacity of about ninety million tons per year. To produce this tonnage, the steel industry's furnaces and converters must be supplied with nearly forty-five million tons of pig iron and forty-five million tons of scrap.

A high percentage of scrap is essential to the metallurgry of some open hearth mills by reason of habit of procedure, just as one cook may use more butter in her kitchen than others do. Nevertheless, enormous tonnages of scrap are essential to the operation of all steel mills; the reason for this is that there is not enough pig iron production capacity to supply the mills. In short, re-melt has regularly provided approximately 50% of steel furnace needs; pig iron capacity, despite expansion, is barely able to keep up its 50% end of the total tonnage requirement for metal going into steel, and hence scrap is in tremendous demand to keep the mills going at their unprecedentedly *continuous high peak*.

Some idea of the volume of scrap consumed by steel mills may be had from an example by John Nuveen, Jr., head of the Chicago branch of the Conservation Division of WPB. The drive for scrap in Chicago has uncovered three long city blocks of


INDUSTRIAL PLANTS
WHAT COULD HAPPEN IF PIPE COILS AND OLD RADIATORS IN FACTORIES WERE SCRAPPED
FIGURES ARE ON BASIS OF 1000 SQ. FT. OF RADIATION
7500 LB OF SCRAP
7500 LB OF PIG IRON
STEEL MILL
15000 LB OF STEEL
14750 LB NET STEEL FOR WAR MUNITIONS
250 LB OF UNIT HEATERS


COMMERCIAL, RESIDENTIAL, INSTITUTIONAL BUILDINGS
WHAT COULD HAPPEN IF PIPE COILS AND OLD RADIATORS IN THESE BUILDINGS WERE SCRAPPED
FIGURES ARE ON BASIS OF 1500 SQ. FT. OF RADIATION
7500 LB OF SCRAP
7500 LB OF PIG IRON
STEEL MILL
15000 LB OF STEEL
14000 LB NET STEEL FOR WAR MUNITIONS
1000 LB OF CONVECTORS

old elevated railway structure that was almost unused and could well go "into the kettle." Those three blocks of steel structure provide enough scrap for only one-half a day's operation of one Chicago mill which represents about 3% of total U. S. capacity.

Thus there is an acute demand for scrap. The needed scrap actually exists, too, for Americans are traditionally careless in their use of all materials. The problem, however, is to collect this scrap into piles from which the steel mills can be fed.

It is suggested that the buildings of this country, particularly industrial plants, are a rich potential source of such scrap in the form of pipe coils or wall and ceiling-hung cast iron radiation. Most American factories and warehouses built prior to fifteen or twenty years ago are commonly so heated. The tonnage of iron and steel scrap recoverable from these sources, if some replacement equipment can be provided for heat dissipation purposes in the buildings concerned, is obviously imposing.

Suggested Program

Consideration is being given to a program designed to bring this potential scrap *into piles* for use of the steel mills. Effort would be to encourage owners of factory buildings containing quantities of old pipe coils and old cast iron radiation to replace these with unit heaters.

The amount of steel used in even a steel-coil unit heater is almost negligible when set alongside the direct radiation scrap to be recovered in this kind of displacement program. A unit heater of 1,000 sq ft of radiation capacity weighs approximately 250 lb; cast iron radiators or pipe coils displaced would weigh approximately 7,500 lb, or a ratio of 30 to 1 in the exchange. This includes an allowance for recovery of extra branch piping, valves and traps, hangars, and so on, since one unit heater would normally replace a half dozen to a dozen direct radiators.

Such a program as this would reap its richest harvest in factories, warehouses, and similar buildings. An appreciable potential exists for displacement of cast iron and pipe coil ventilating and process heat exchangers by steel fin-and-tube coils. Here the recovery ratio would be much lower than that estimated for unit heater versus direct radiation, the labor and incidental costs proportionately greater.

But factories are by no means the only source of such scrap. Existing radiators in houses, apartments, commercial buildings and institutions are, in many cases, outmoded, and ripe for the scrap pile. In such buildings steel convectors, with non-metallic enclosures, could replace the radiation. Scrap recovery would be in the ratio of 6 or 8 to 1; in other words, removing 1100 to 1500 sq ft of radiators would yield 7500 lb of scrap and require perhaps 1000 lb of steel for the same capacity in convectors. But since one convector would be required to replace one cast iron radiator and since inevitable piping changes would ensue in most instances on such exchanges, labor cost would be high in man-hours if not in dollars. Moreover, an exchange of this kind would play hob with decorations. However, it is not impractical to conceive that the millions of square feet of cast iron radiation installed in our spanking new cantonment and ordance buildings during the past eighteen months, could well yield to equal capacity

of steel convectors, containing only a fraction as much of metal, inasmuch as piping niceties and decorative amenities are not so exacting in these buildings.

Costs

Who pays, and how much? Well, such a replacement could be a true bargain for most factory buildings. Especially so with the threat of reduced fuel quotas looming. For both laboratory study (Larson, Nelson and James, University of Wisconsin, 1934, "Test of Three Heating Systems in an Industrial Type of Building") and innumerable practical instances on record show savings of from 13% to 25% of fuel where unit heaters were installed in place of direct radiation. Economies of unit heaters trace to lower temperature gradients and to facility of on-and-off control, preventing over-heating and reducing the period of unoccupied full- temperature heating.

Outlay would approximate 3 to 5 cents *per square foot of factory floor space* for replacement of direct radiation with unit heaters. Offsetting this would be an allowance of about 1 cent per square foot of factory floor space for scrap metal. (The unit "square foot of floor space" is employed here because any factory owner or executive knows this unit on his plant.) A rule-of-thumb indicates 1 lb of scrap per square foot of factory floor space as a likely recovery for multi-story buildings, and up to 1½ lb per square foot of floor for top floors of multi-story buildings and for single-story structures.

Conceivably the Federal Government may determine that the need for scrap is so acute that measures for financing or even subsidizing radiation replacement programs of the kind mentioned are justifiable.

Manufacturers of unit heaters and similar extended surface equipment and their field engineers are likely to be called upon to take energetic steps in a national salvage program during the months just ahead. It goes without saying that the heating contractor and jobber would be looked to for a major part in any such program, particularly inasmuch as they are now being freed from the demands placed upon them in recent months arising out of our huge war construction schedule.

It is apparent that the project would be no small one, for if the estimate of a million tons of scrap per year recoverable from the project is at all accurate, the market value *merely of this scrap* would approximate twenty million dollars.

What is by far the most important phase of this situation is that there may be a chance here for the heating industry to make a more tangible contribution to American war effort than it accomplishes even when it heats a war production factory. *For our full production of ships and tanks and guns depends directly upon steel output, and our full steel output depends critically upon availability of scrap!*

On the Whole Washington Officials Keep Cool

A newspaper reporter in Washington last summer visited a number of federal office buildings to determine if fuel conservation was being carried on in the government's own headquarters. At the same time the reporter questioned various individuals connected with the building as to their idea about what temperature should be maintained inside.

Surgeon General Thomas Parran called the ideal temperature 68F, acknowledged that many of the office buildings were much too warm, and reported that he attempts to maintain 68F in his own office. Another official of the Public Health Service believed 70 to 72F was a good working temperature but that too many factors were involved to set any definite figure. At the War Department discussion of inside temperatures was considered to be restricted information.

At the Department of Justice the temperature strived for but not always obtained was said to be about 73 to 75F, while an assistant building superintendent at the State Department said that they usually aimed at between 75 and 76F.

In the Senate wing of the Capitol the temperature ranged from 75 to 78F while under the great dome of the Capitol a low temperature of 73F was reported.

Major Leon L. Gardner, in the office of the surgeon general of the Army, said he has found temperatures ranging from 51 to 91F in offices of the War Department annex. The reporter indicated that the theoretical temperature at the White House is 78F but in practice it is usually much lower.

Temperatures in the House end of the Capitol were reported as ranging from a high of 78F in the Speaker's lobby to a low of 74F in the first-floor corridor.

The office of Harold L. Ickes, Secretary of the Interior and Petroleum Co-ordinator, was at 67F when the reporter made his survey and furthermore, an aid reported that Secretary Ickes prefers it cooler than that.

Secretary of Labor Perkins' secretary reported that Miss Perkins liked her office cool.

The Navy Department did not restrict information on inside temperatures and said that 72 to 78F was maintained in a building not air conditioned. In Secretary Knox's air conditioned office the temperature is kept at 70 to 72F.

In the press room of the air conditioned Social Security Building which houses Donald M. Nelson and his War Production Board, the temperature was 72F at the time of the survey.

Military Clinic Air Conditioned by Absorption Units

By ROBERT LATIMER

A 100-TON year-round air conditioning system consisting of 20 five-ton gas-fired absorption type units, installed in a matter of days rather than months, has been placed in operation in the Dr. Ochner Clinic, a converted office building now being used by the U. S. Army for the examination and treatment of soldiers slated for foreign service.

The Dr. Ochner Clinic, one of the largest medical-specialty buildings in the South, was formerly used for business offices, and housed a few private physicians. Under the pressure of war, requiring special treatment and examination of troops sent to foreign points, it was decided to convert the five-story building into a structure housing specialists in various diseases, and to use it entirely for military examination and treatment purposes. The building is now devoted entirely to the offices of specialists in pediatrics, psychiatry, gynecology, minor surgery and eye, ear, nose and throat diseases.

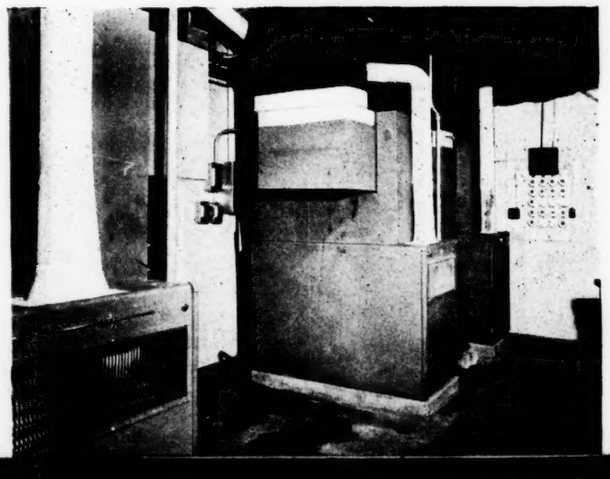
Air conditioning was deemed essential by the management on making the conversion, not specifically for comfort cooling, but because of the need for evenly-controlled temperatures in the treatment of ailments. Originally a central cooling system distributing refrigerated water to individual fan stations was specified, then rejected due to lack of a basement or other space, and the need for rapid changeover. After considering several means, Gulf Engineering Company, large contracting and air conditioning firm, supplied a practical answer with absorption-type packaged units, burning gas for both heating and cooling on a zoned basis. Although original costs were demonstrated as approximately $5000 more than for a similar-capacity central system, use of the flexible, individually-operating units would save the Clinic upwards of $1800 per year in operating costs.

Twenty 5-ton units were used to air condition and heat five floors through the building. The total 100 tons of cooling capacity is distributed over the five floors in zones, four to a floor, approximately 1400 sq ft per zone. Each zone contains from one to eight offices, depending upon the nature of the treatment, and is considered as an entirely individual heating or cooling load. The heating and air conditioning loads are highly variable, as it was required that one zone of each floor could be cooled while units in other zones are heating or are inoperative; some offices are used only two or three days a week, while others are busy 24 hours a day. Some of the offices contain research laboratories, testing rooms, or refrigerated storage spaces used over the weekend throughout the year, requiring considerable air conditioning capacity over Saturday and Sunday.

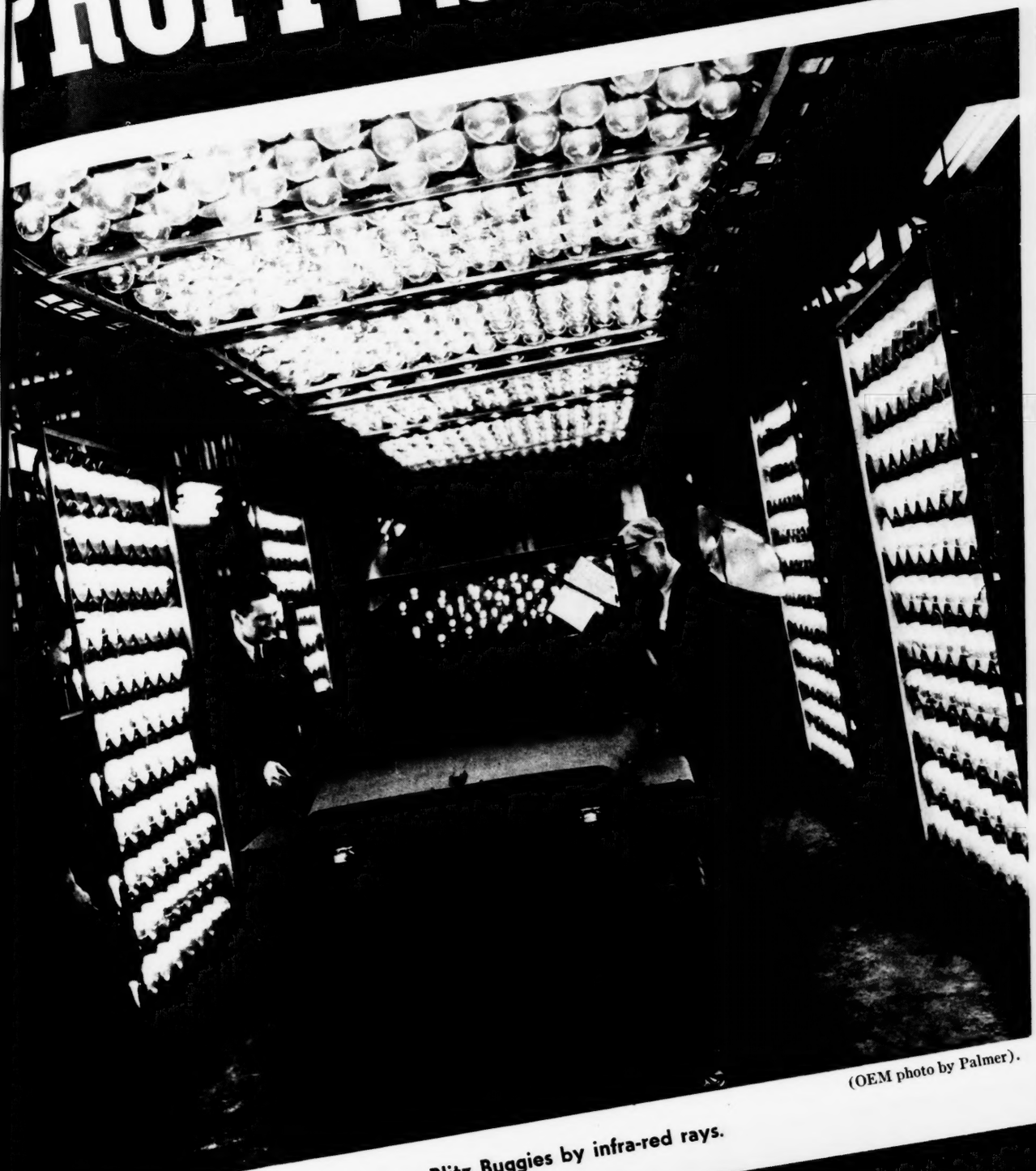
In making the installation, to conserve space, the Gulf Engineering Company walled in a former 12 x 14 ft light shaft running up the back of the building, flooring this at five levels, and insulated the walls. This provided five air conditioning machinery rooms to existing space without expensive remodelling. Four conditioning units, two on each side, have been set up in the light shaft space on each floor, each handling a north, south, west or east corner of the floor. All units on each floor are connected with a 400 gpm forced-draft cooling tower atop the building roof, convenient for repairs and service. The units thus are readily removable for replacement on repairs, and enough space is available to make changes easily. Each unit is connected with the quarter-floor zone it serves by ducts. Manual dampers and thermostat controls are provided at the supply grilles for automatic or manual control. A normal summer condition of 78F with 60% relative humidity is maintained in all but the very largest treatment rooms. Return air passes down the corridors of each floor through baseboard grilles.

The capacity of each conditioner system ranges from 5500 to 7000 cfm. Provision has been made to use blowers only for ventilating during the mild Spring and long Fall period, with outside air intakes through the outer wall of the light shaft.

Four typical Servel units in Dr. Ochner's Clinic. Note the insulated ducts.



PROFITS IN AIR



(OEM photo by Palmer).

Drying paint on Blitz Buggies by infra-red rays.

...OW INDUSTRIAL PLANTS PROMOTE PROCESSES BY CONTROL OF AIR CONDITIONS

METALLURGICAL

FOODSTUFFS

ORDNANCE

CHEMICALS

AIRPLANES

FOUNDRIES

TOBACCO

TEXTILE

BAKERIES

ELECTRICAL

FILMS

INSTRUMENTS

GLASS

MACHINE SHOPS

PHARMACEUTICAL

PLASTICS

PAPER

RUBBER

PRINTING

PROFITS IN AIR

MINNEAPOLIS-HONEYWELL REGULATOR CO.

designs and installs a special humidity control system for its own plant to facilitate production on accurate optical parts for war equipment.

By J. E. HAINES

Manager, Air Conditioning Controls Div., Minneapolis-Honeywell Regulator Co.

DURING 1940 the Minneapolis-Honeywell Regulator Company contracted to manufacture gun sights, and with no previous experience in the grinding and polishing of glass lenses, set out to determine the best means for manufacturing these sights on a quantity production basis. To obtain the accuracy and efficiency required in making today's military optical equipment, absolute cleanliness is essential. A particle of dirt or foreign body one ten-thousandth of an inch in diameter renders the sight absolutely useless. Visualize a man peering through his sight and scanning the horizon for that tiny speck—thousands of feet away—that might be an enemy bomber, and then with all on the alert and ready for action, it is found that this object was only a dust particle on the face of the optic itself—a piece so small that it would have to be enlarged 10,000 times to become the size of a quarter. Such is the magnitude of a microscopic error. A corresponding demand for cleanliness, accuracy and efficiency naturally follows.

This means that the personal cleanliness and tidiness of workers is of prime importance. They must wear spotlessly white uniforms, work in closely controlled atmospheric conditions—with the air purified and with air conditioned surroundings, in absolute dust-free rooms, and with benches over which are placed dust hoods to collect that last particle of free dust.

The preliminary investigation indicated that glass was hygroscopic and could give off moisture, which under certain conditions would collect on the surface of the glass and prevent effective polishing. To prevent this collection of moisture it was first believed that it would be necessary to accomplish the polishing in a very dry atmosphere, and the preliminary production was started in a small space where the relative humidity was maintained at

The Minneapolis-Honeywell Regulator plant in Minneapolis where optical parts are being manufactured for the Navy

approximately 20%. However, it was soon determined that if the relative humidity dropped as much as 2%, the glass would give off moisture which would collect on the surface of the glass and prevent efficient polishing even in an atmosphere at approximately 20% relative humidity.

Further experiments proved that on a gradual rise in relative humidity, the glass absorbed moisture and the polishing process could be accomplished more easily at relative humidities up to 45%. Therefore, a special humidity control was designed which not only provided for very accurate moisture regulation, but also automatically increased its humidity control point at the rate of 1% per hour during the working period and then dropped the relative humidity back to a predetermined point during the night.

During the early part of 1942 a comparatively large space was air conditioned for the grinding and polishing of glass lenses, and this special humidity control is being used as the master control in this space. As the relative humidity control point is automatically increased at the rate of 1% per hour, the relative humidity varies less than ½% from the control point. Steam reheat is available during both summer and winter to maintain the temperature in the space. When the outdoor temperature is less than 45F, outdoor air is used as required for dehumidification. Two additional spaces are being air conditioned for the same purpose at the present time and will be in operation shortly, using the same type of control.

This first air conditioning system was designed by Ralph Bloom, consulting engineer, and installed by the Spencer Air Conditioning Company, contractors, both of Minneapolis.

Figs. 3 and 4 illustrate the special humidity control. This consists of a standard pneumatic humidity control with a special deflector to prevent air escaping through the control nozzle from affecting the control point of the hair element. A time clock is installed beneath the humidity control with a special cam which raises and lowers the humidity control point according to a predetermined schedule. Fig. 5 is a schematic illustration of the mechanical equipment and the control layout.

The fan delivers 22,000 cfm, including a minimum of 3,500 cfm of outside air. The refrigeration compressors have a capacity of 86 tons and the condenser is cooled by well water taken from another air conditioning system at 60F during the cooling season after passing through the cooling coils of the other system. Approximately 325 gpm of water are pumped to the washer.

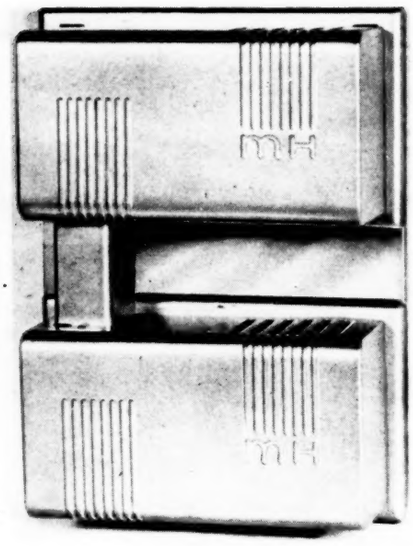
The control system is completely automatic and does not require any manual changeover between the heating and cooling cycles. The following outline describes the detailed operations of the control system:

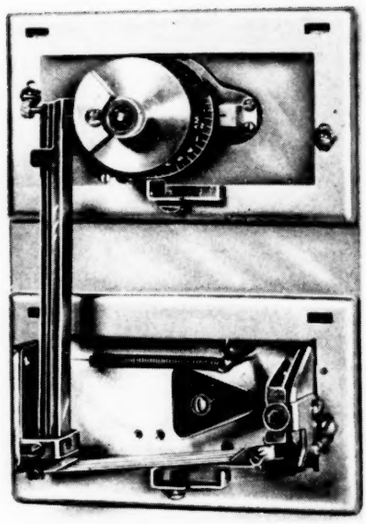
(1) *When the Fan is Started*

(a) The spray pump is started;
(b) The circulating pump is permitted to run if mechanical dehumidification is required;
(c) The compressor is permitted to run if refrigeration is required; and
(d) The outdoor air damper is permitted to open to its minimum position at the command of the graduate switch or farther open at the command of the sub-master dewpoint controller.

Fig. 1. Naval officer peering through one of the Navy gun sights. The upper part of the sight has been blanked out by the censor.

Fig. 2. The officer in Fig. 1 is focusing on the tip of the Foshay Tower in Minneapolis. Here is what he sees through the sight.





Figs. 3 and 4. Exterior and interior of the special humidity control.

(2) *Humidity Control*

(a) The humidity control in the conditioned space resets the control point of the sub-master dewpoint controller according to a predetermined schedule;

(b) The sub-master dewpoint controller measures the temperature of the air leaving the air washer. On a rise in air dewpoint temperature the following sequence takes place:

1. The preheat coil steam valve is graduated toward its closed position as less humidification is required;

2. If the outdoor temperature is below 45F, the outdoor air damper is then graduated from its minimum position toward its open position as more dehumidification is required. The refrigeration compressor is not permitted to run and all the water to the air washer is recirculated when the outdoor air is 45F or less;

3. If the outdoor temperature is above 45F, the outdoor air damper remains at its minimum position, and when dehumidification is required, the compressor is started, thereby providing chilled water for the washer. Also, the circulating pump is started so as to prevent freezing the cooler. As more dehumidification is required, the cold water valve is graduated toward its open position, and the recirculated water valve toward its closed position;

4. The refrigeration compressor is operated in four stages through pneumatic-electric relays controlled by a temperature controller measuring the temperature of the water leaving the cooler.

(3) *Temperature Control*

The room thermostat graduates the reheat coil valve to provide for the proper amount of reheat. The temperature controller in the discharge air may assume command of the reheat coil steam valve so as to prevent the temperature of the discharge air from falling below a predetermined point.

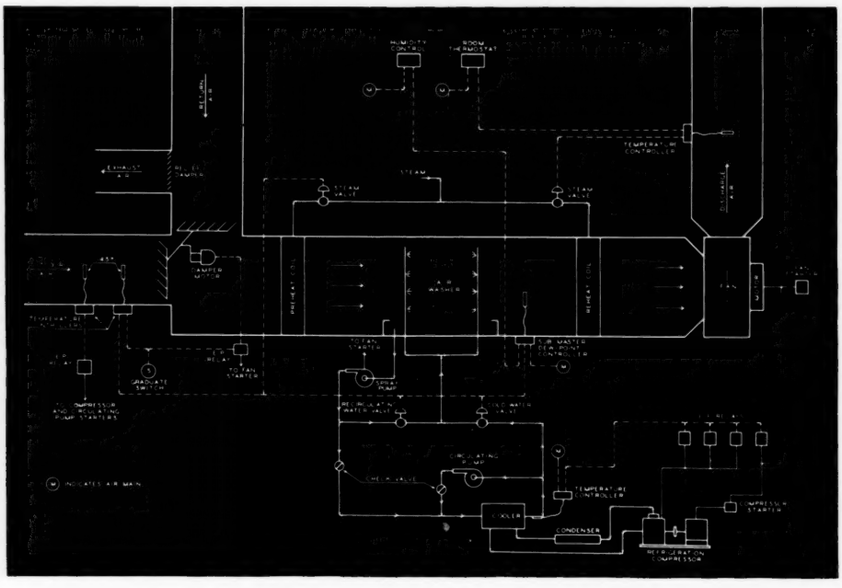


Fig. 5. Schematic diagram showing the arrangement of the controls for the humidity control system in the Minneapolis-Honeywell plant.

Sawdust Burners Heat Buildings and Homes Automatically

By E. C. WILLEY

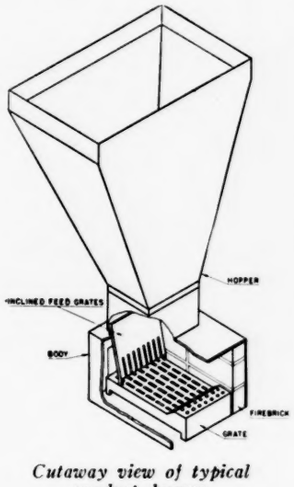
Assistant Professor of Mechanical Engineering
Oregon State College

Wood is still an important fuel in many parts of the country. In this article the author gives an idea of the vast amount of waste wood burned under the boilers of sawmills and woodworking plants for generating steam used in central heating, process work, and power. The large amount wastefully burned merely as a matter of disposal, due to lack of markets, also is pointed out, this being particularly pertinent in these days of conservation in all things. The development of small automatically-controlled sawdust burning units for domestic and commercial heating also is discussed.

IT probably is difficult for the casual observer to understand why there has not been more effort in the past to make good use of the vast amount of waste wood from the lumber mills of the country. Although there has been some effort in this direction, it still is true that there are thousands of tons of it burned every day in open fires and refuse burners over the country. In general the question may be answered by viewing the circumstances and conditions which surrounded our early sawmills. The first sawmills were located in the heart of the large forests which were away from the most populated districts. Those living any short distance from the mills were not interested in the sawdust and waste wood of the mill because cord wood was so plentiful and this could be burned in the fireplace or simple stoves of that time.

However, since the improvement of our highways and transportation, and since there are larger populated districts in closer proximity to our mill centers, this picture is changing. Not only is there less cord wood available in the wood lots, but the labor problem has added so much to the cost that cord wood is now almost out of the picture in some sections. Parallel with these conditions is the demand by the general public for fuels which can be fired automatically. As a consequence, equipment is now being developed to use sawdust and other mill waste for both large commercial and small domestic purposes.

For several years the sawmills have been using the waste wood for generating their mill power. Developments made by them, however, have been confined mainly to the bettering of handling facilities rather than to improving types of burners. On the other hand, considerable work is being done on improvement of domestic burner design. It is the aim of this paper to point out these developments in handling and burning equipment, but first there should be a discussion of the source and potential heat quantity of this fuel.



Cutaway view of typical sawdust burner.

Source of Supply

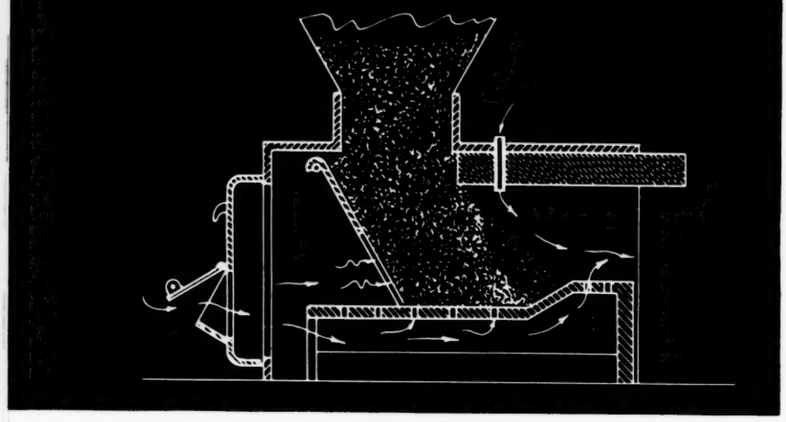
As might be expected, the most heavily-wooded sections of the country are the largest sources of waste wood fuels, these regions being the northwest, south, and northeast parts of the United States and most of Canada. Although the ultimate available supply depends on the amount of standing timber, the actual availability at any time depends on the output from those sawmills which are in operation. According to authorities, the average sawmill uses about 60% of its waste wood for generating its own power. The other 40% is then available for marketing or must be disposed of by burning. For every thousand feet of lumber sawed the mill will have about one unit of waste. A unit is 200 cu ft.

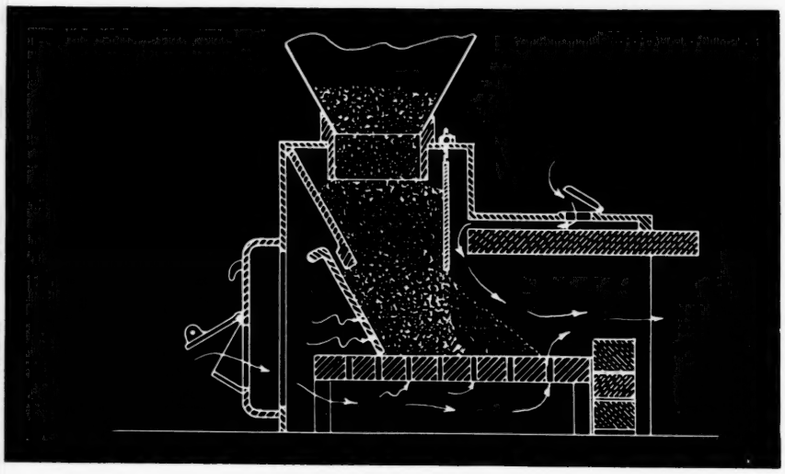
Until the mills found that there was a commercial value to this waste, they used only the sawdust from the saw and the shavings from the planers for burning under their own boilers. However, now they use everything. The large slabs, edgings and ends are put through a large machine where rotating knives cut it into small pieces less than an inch in diameter. The machine is called a hog and the product is called hogged fuel. When this hogged fuel is sold, it generally contains considerable sawdust mixed with it.

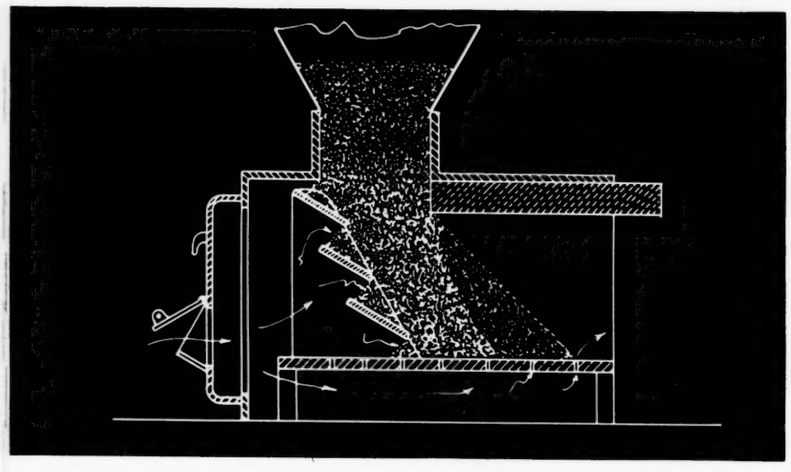
Heating Value

The heating values of wood vary with moisture content and other physical characteristics. Presence of resins, gums, and oils has a corresponding effect on the heat content of the fuel. The average moisture content of Western Douglas fir is about 42% as taken from the mill. At this moisture content an average unit of 200 cubic feet, weighing about 3,700 lb, would contain about 17 million Btu. With the average installation using 50% excess air and 500F stack temperature, there would be available about 13 million Btu of heat for useful output.

From various field tests and labora-







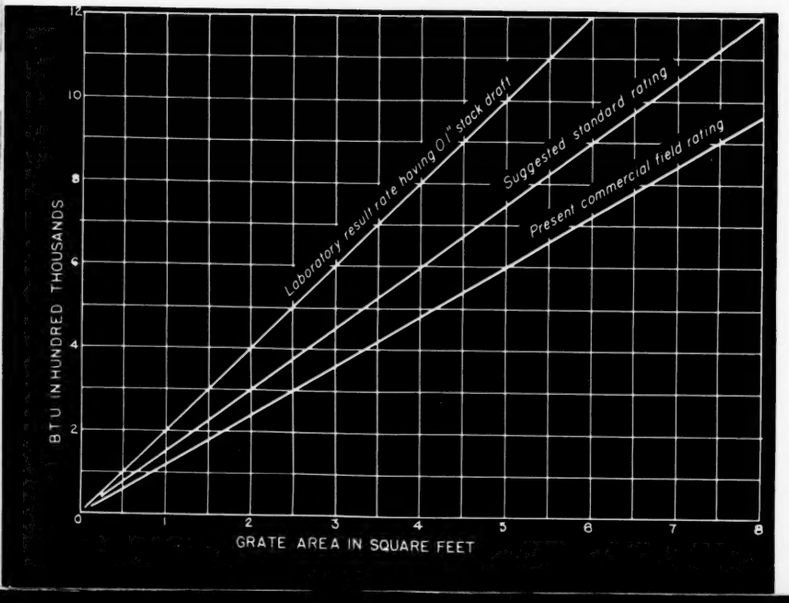

BTU IN HUNDRED THOUSANDS
GRATE AREA IN SQUARE FEET
Laboratory result rate having 0.1" stack draft
Suggested standard rating
Present commercial field rating

TABLE 1.—GROSS HEAT VALUES OF SAWDUST BY UNITS

Species	Moisture Content, Per Cent	Weight of Unit, Pounds	Available Heat, as Fired,	
			Btu per Pound	Btu per Unit
Douglas fir	42	3,750	4,550	17,040,000
Hemlock	51	4,300	3,440	14,800,000
Yellow pine	45.3	4,050	3,268	13,200,000
Red cedar	44	2,700	4,930	13,320,000
Sitka spruce	48	3,320	3,605	11,970,000

tory data obtained, Table 1 has been prepared, based on an assumed stack temperature of 500 deg. F.

The gas analysis on field tests often shows from 16 to 18% carbon dioxide in the flue gas compared to 21% under perfect conditions.

The greatest efficiency is generally found in large commercial plants where trained attendants, using instruments, keep constant watch over the equipment 24 hours a day. As high as 65% efficiency is sometimes obtained under these conditions, where the small domestic units will do well to get from 25 to 40%.

Handling

Transportation and handling of this fuel has been almost as big a problem as the design of equipment to burn it. As each of these problems is simplified, so is the increase of its use at points farther removed from the timbered centers from where it is taken. The most economical method of transportation is by water on barges. For long hauls inland the railroads have built large bodies on flat cars with side outlet doors. Short hauls are made by special dump body motor trucks.

In the sawmill and at the large commercial steam plants the fuel is handled by belt and chain conveyors. At the mill, conveyors take it directly to the plant boilers or to awaiting conveyances which take it from the mill. In places where there is considerable call for the fuel a storage pile generally is maintained and to this the excess is diverted when it is not being conveyed away.

The fuel is then taken to the large inland power or heating plants by railroad cars or motor trucks. The plants are equipped with belt or chain conveyors and bucket elevators which carry it to the boilers or to the storage pile.

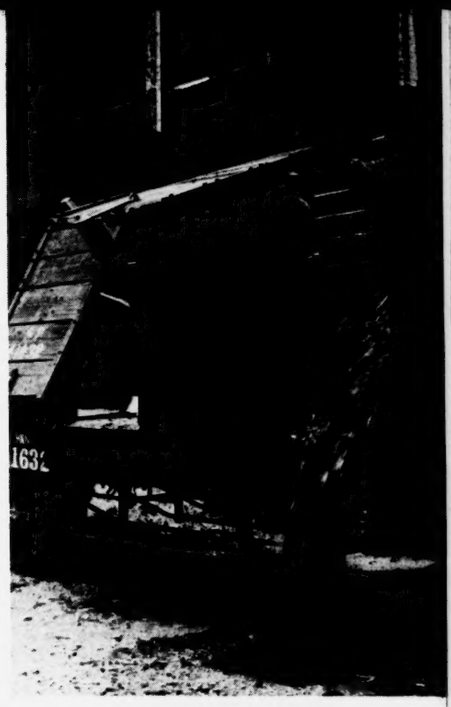
The early designs of fuel handling equipment were very crude. During the past few years the increased demand for the fuel has been responsible for the remarkable improvements in this handling equipment. The writer has had opportunity during the past fifteen years to visit most of the biggest and best equipped plants in the northwest and has taken oc-

(Top) Cross-section of typical sawdust burner showing incline on front end of lower grate to insure that openings for secondary air be kept clear.
(Upper center) A burner with two-piece feed grate and adjustable apron ahead of incoming sawdust to control rate of flow.
(Lower center) Burner with a three-step feed grate. In this particular burner the auxiliary air is admitted through the side walls.
(Left) Domestic sawdust burner rating curve.

casion to study and note these improvements.

A very complete and well-working unit may be found in the heating plant of the Oregon State College, situated inland and at some distance from any large size mills. Fuel for this plant is brought by motor trucks and railroad cars. The equipment to handle it consists of an underground conveyor which takes the fuel from under the car and carries it to a large central elevator. From the elevator it is conveyed to a point over the dutch ovens of the boiler and fed to them by chutes. From the elevator there is also a conveyor which may carry the fuel to a storage pile. Another receiving conveyor similar to the first one is used in receiving the fuel from motor trucks which take it to the same elevator where it is handled as before.

Still another conveyor runs the entire length under the storage pile, and into this the fuel is directed for reclaiming.



Unloading hogged fuel from the railroad car to underground conveyor.

Storage

Mention might be made here about the desirability of furnishing shelter for the storage of hogged fuel. Considerable study has been made to determine the amount of heat which is lost through the deterioration of the fuel from internal heating. In the pile a process of fermentation and internal heating takes place similar to that which occurs in new hay. As this would happen regardless of whether or not it was sheltered by a roof, the whole question of roofing depends on the value of keeping out the excess moisture received from rains. Most of the large plants which maintain large storage piles feel that there is not enough added saving of heat to justify the expenditure for providing roof shelter.

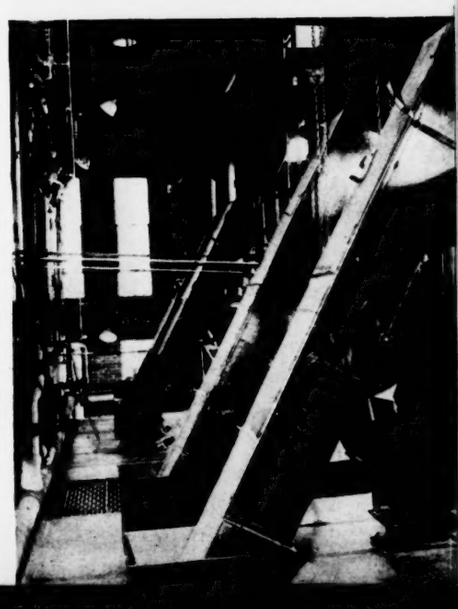
The overhead chain belt conveyor which carries the hogged fuel to the feed chutes over the boiler dutch ovens.

Types of Burners

Both the large commercial burners and the small domestic type are built on the principle of the old dutch oven. In both cases the fuel is admitted from above and burned on grates. The flame from the dutch oven passes into the combustion chamber of the boiler or furnace, giving the fuel much larger combustion space and longer travel while burning. In the large commercial size burners a baffle or bridge wall generally is used, this keeping the fire from short-circuiting and carrying small unburned particles up into the tubes and breeching of the furnace.

In the large size industrial burners the fuel which is fed into the top of the dutch ovens builds up in conical shaped piles. This makes it necessary for the air which supports combustion to be admitted above the fuel bed. The small amount of air admitted below the grates (generally about 10%) will find its way through the periphery of the pile where the fuel bed is shallow.

In general this one point of design is the main difference between the large commercial plant burners, and the small domestic type. In the domestic burners practically all of the air for combustion is taken through the fuel bed. The small amount of secondary air used is needed to keep the fire from



The chutes which connect overhead conveyor to hoppers in dutch ovens. The total boiler capacity is 1500 hp.

extinguishing when the burning embers are completely covered by fresh fuel.

The small domestic burners, as shown in the accompanying cuts, differ mainly in the shapes of grates and methods of introducing secondary air. They are all built on the same dutch oven principle and are placed in front of and connected with the furnace so that the fire brick lining of the burner and that of the furnace are continuous. When installing a sawdust burner with a coal or wood burning furnace it is generally attached to the ash pit door opening and the lower part of the furnace lined with fire brick accordingly.

The design of feed hoppers has been fairly well agreed upon by manufacturers, but the design of the sloping grates and other parts of the entering throat are still a matter of experimenting. This would not be the problem it is if a standard uniform texture of fuel was available. However, such fuel cannot be had and consequently there is a most urgent problem of design for our engineers and manufacturers. The smaller the size of the burner, the more important it is that the fuel be not only of fine grain but of uniform moisture content. Whenever a small burner is designed which will burn hogged fuel, there will be a much greater demand for the mill waste.

Performance

In 1941 the writer concluded a series of tests made with domestic sawdust burners to determine primarily the method of rating. From these tests it was found that the average efficiency was about 41%. Fuels of all ages and moisture content were used and the heat content as fired averaged 4,790 Btu per pound. The average output in the laboratory was 158,000 Btu per sq ft of grate per hr. All tests were made with continuous firing, that is, three to eight hours or more at a run. Tests were made using varying stack pressures and draft openings and it was found that the highest ratings were obtained when the draft was about 0.1 in. of water. The highest rating found was 204,000 Btu per hour per square foot of grate.

Rating

It is reasonable to expect about 80 lb of fuel burned per hour per square foot of grate. The average noted in the laboratory was 83.5 lb, which included the test runs where a low stack draft was maintained.

This burning rate seems abnormally high when compared with results made by Henry Kreisinger (Combustion Engineering Co., New York) in the Bureau of Mines Laboratory in Pittsburgh, Pennsylvania, and reported in *Mechanical Engineering*, February, 1939. However, in the same article he points out that hogged fuel would not burn so readily as sawdust, since the particles are larger.

There has been a tendency of the manufacturers to underrate their burners and when these oversize burners were placed in the field they gave maintenance troubles, such as creosoting, backfiring, and overheating of the space being heated, which were directly traceable to their being oversize. The writer spent considerable time in the field investigating home installations and also worked with the manufacturers to determine their method of rating. The conclusion was very definite that most installations were much larger than necessary.

Tests also showed that the small burners should have sufficient stack draft available to insure pulling air through the body of the fuel bed, 0.1 in. of water being the minimum deemed advisable, although more or less satisfactory operation can be maintained at less draft.

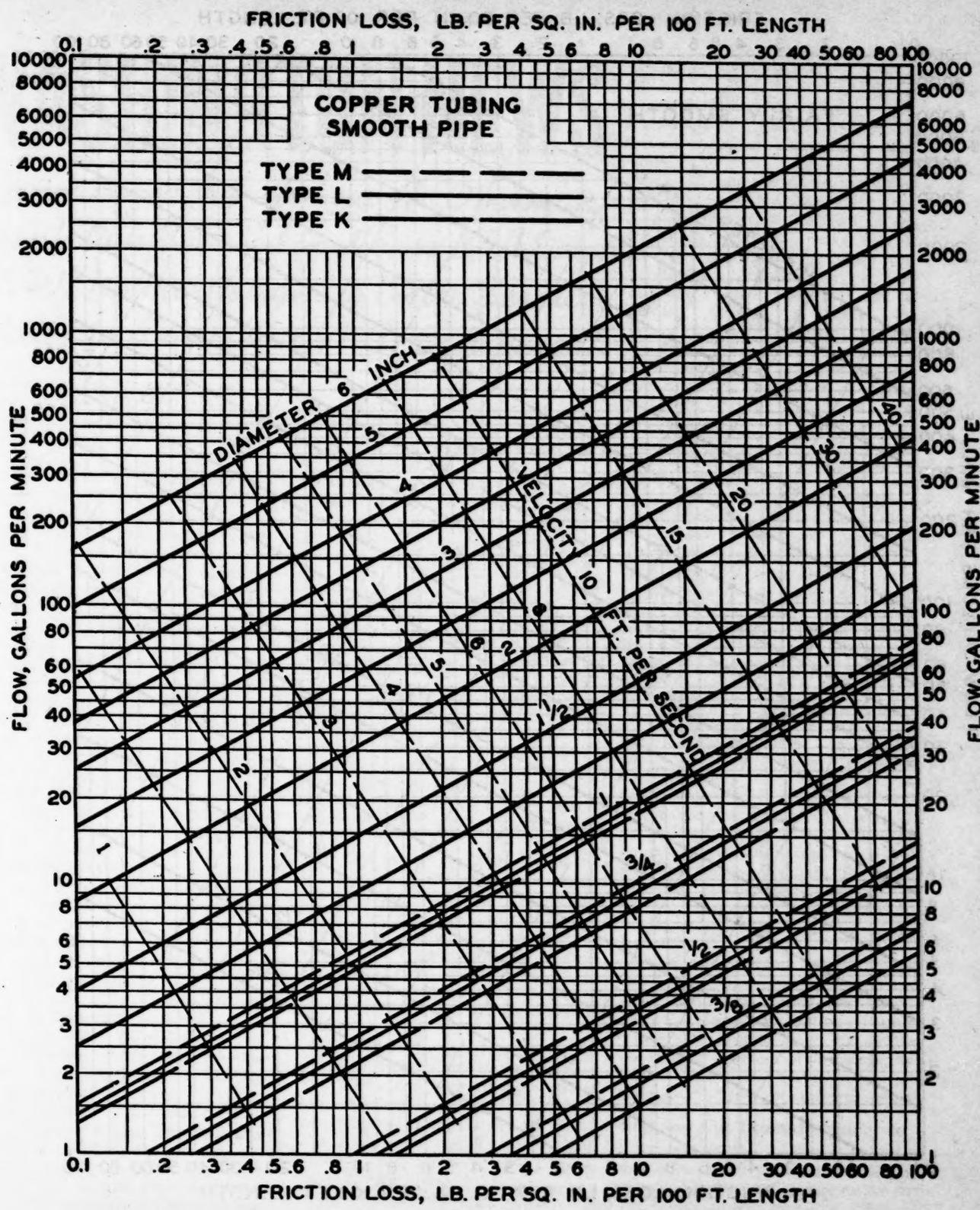
For all general calculation work, one should estimate about 150,000 Btu per square foot of projected area of grate in selection of a domestic burner. For rating the larger industrial burners it is customary to allow a range of from 3 to 6 boiler horsepower per square foot of grate.

Automatic Control

One of the attractive features of domestic sawdust burners is the possibility of using automatic control. By having thermostatic controls which open and close the draft of the burner, it is possible to keep a very close temperature gradient, and at the same time save as much as 25% of the fuel. Having a hopper feed, it is possible to go for long intervals between firing.

The storage pile at Oregon State College heating plant, showing the elevator tower and overhead conveyor leading into plant.

PIPE AND TUBING FRICTION CHART—SMOOTH PIPE


FRICTION LOSS, LB. PER SQ. IN. PER 100 FT. LENGTH
0.1 .2 .3 .4 .5 .6 .8 1 2 3 4 5 6 8 10 20 30 40 50 60 80 100
COPPER TUBING
SMOOTH PIPE
TYPE M
TYPE L
TYPE K
DIAMETER 6 INCH 5 4 3 2 1 1/2 1 1/4 1 1/2 3/8
VELOCITY 40 30 20 15 10 8 6 5 4 3 2 1 FT. PER SECOND
FLOW, GALLONS PER MINUTE
10000 8000 6000 5000 4000 3000 2000 1000 800 600 500 400 300 200 100 80 60 50 40 30 20 10 8 6 5 4 3 2 1
FRICTION LOSS, LB. PER SQ. IN. PER 100 FT. LENGTH

The above friction chart for smooth copper pipe with streamlined fittings is designed on the basis of actual copper tubing diameters but with nominal sizes indicated. This chart can also be used for brass pipe (I.P.S.) with recessed fittings by taking into account differences in diameters. For Fairly Smooth pipe, see other side of this sheet; for Rough and Fairly Rough pipe, see Reference Data 233-234.

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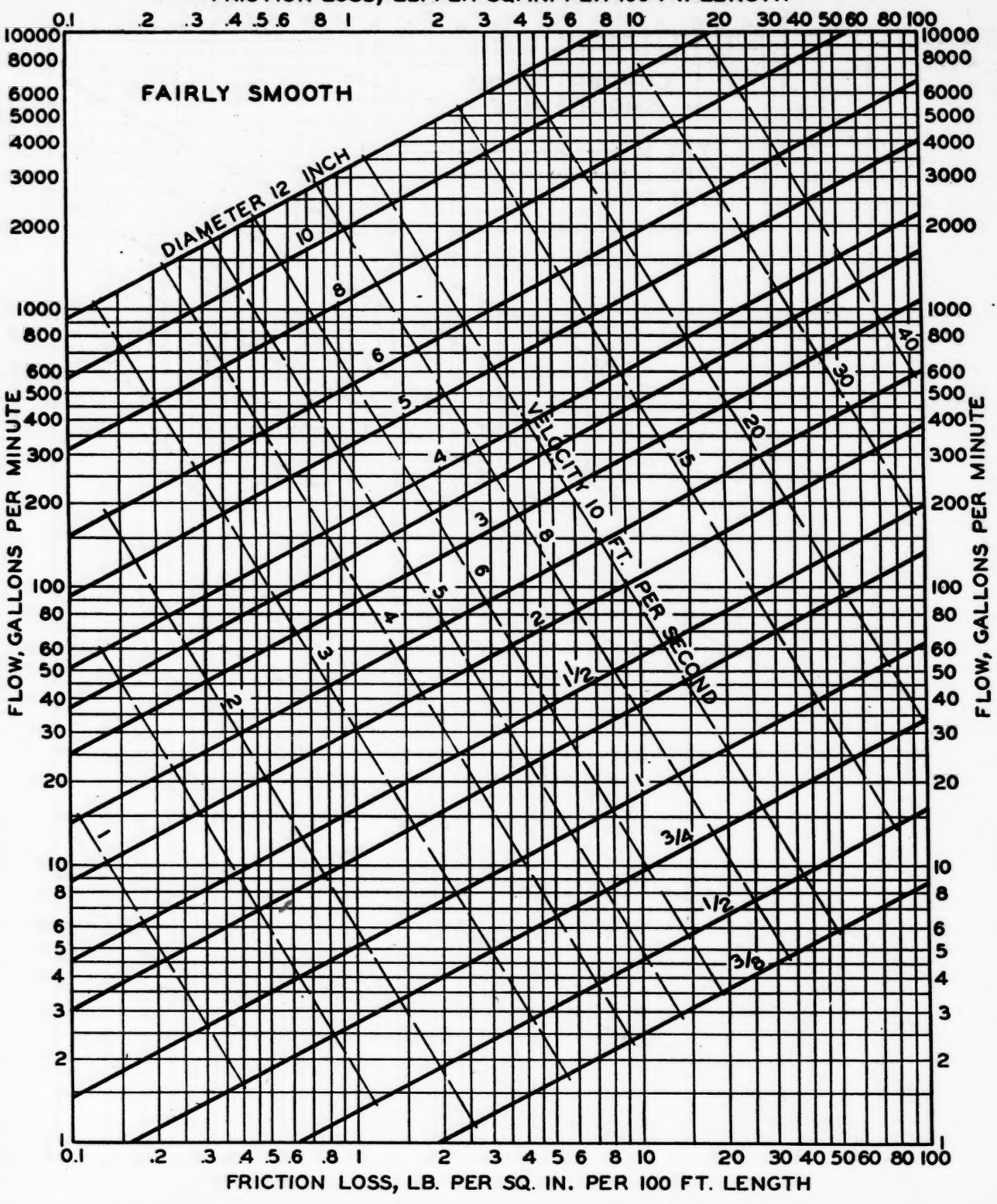
H. & V.'s REFERENCE DATA—231

PIPE FRICTION CHART—FAIRLY SMOOTH PIPE



The charts on this sheet are intended for use in designing water piping, and are computed on the basis of actual diameters but with nominal sizes indicated. They are based on data of the National Bureau of Standards. The above chart applies to new steel or wrought iron pipe. For Smooth (tubing) pipe, see other side this sheet; for Rough and Fairly Rough pipe, see Reference Data 233-234.

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H. & V.'s REFERENCE DATA—232

WASHINGTON NEWS

Summarized by Loring F. Overman. Insulation Favored in House Building; W. W. Timmis Resigns to Enter Service; Stores to Contribute A. C. Equipment.

Despite the many negative implications of the OPA fuel rationing program (see page 61 for complete details) perhaps there will be a silver lining:

Out of the enforced "trial by discomfort" should emerge an entire East Coast populace with a thermal efficiency complex that should augur well for the heating, ventilating and air conditioning industry for years following the defeat of Hitler and Hirohito.

Never before has the public been given such a selling argument as the OPA's promise to reward, with extra fuel oil, those who take the trouble to raise the thermal efficiency of their homes—and to withhold fuel from owners or occupants of sieve-like structures wasting more fuel than they convert into usable comfort.

For years the industry has preached the very real advantages of efficient heating plants, storm windows, weather-stripping and insulation. Many have heeded the call, but greater numbers with tongues in cheek, have murmured, "sales talk."

To such doubters it may come as a shock to have OPA forcefully verify the industry's entire educational and trade promotion program by applying the following yardsticks:

Group A—Fuel reductions as low as 15%. Homes where every possible method has been used to achieve highest thermal efficiency;

Group B—Fuel reductions ranging from 15% to 33-1/3%. Homes above average in thermal efficiency;

Group C—Fuel reductions averaging 33-1/3%. Homes rated as Standard. (90% combustion efficiency and .15 insulation), and

Group D—Fuel reductions ranging from 37% to 40%. Homes rated by OPA rationing boards as "sieves."

As explained to business paper editors, meeting with OPA in Washington September 26, the fuel oil transportation problem is very real, and it is not the intention of administrators of the program to permit fuel oil to be wasted by those too shiftless to adopt known methods of conservation.

Similarly, OPA's Joel Dean told business paper editors that the lesser reduction is assigned the more efficient homes on the assumption that owners have already effected important fuel oil savings by installation of heat-loss preventives.

Despite the relatively favorable position of those who occupy homes that are thermally efficient, they too face the likelihood of chiller-than-usual rooms unless they can make arrangements to feed coal-generated heat into their living spaces.

The question of "reasonable cost" of converting from oil to coal attracted numerous questions at the editors' conference. Local OPA boards will base their answers upon four criteria:

1. How much per barrel will it cost to convert? (To date conversions have usually been indicated when the cost is less than $1.00 per barrel per season. When the cost varies between $1.00 and $2.00 per barrel per season, some choose to convert, and when costs exceed $2.00 per barrel conversion is seldom considered advisable).

2. What is the subject's relative ability to finance conversion?

3. Will conversion interfere with the war effort?

4. What does the survey of available equipment reveal? (Does the owner already have grates, doors, shakers, lugs, etc.?)

For private dwellings, conversion is not mandatory. All occupants of homes now heated by oil will receive a basic ration determined by formula. Thereafter the occupant must decide whether to continue setting his thermostat lower than he has in the past, or to enjoy the balmier benefits of conversion.

For all but private dwellings, conversion is mandatory if it can be accomplished within the definitions of the four questions above. If the rationing board rules in favor of conversion, no oil rationing coupons will be issued to those not classed as private dwellings. If conversion is impractical, a straight 33-1/3% reduction in fuel allotments is contemplated.

OPA officials attending the September 26 conference were questioned at length regarding the basis of the announced 33-1/3% reduction. It was explained that the figure was arrived at by considering the best estimates of available supply and by debating whether to accept the higher total of Petroleum Coordinator or the lower estimate announced by WPB and the Office of Defense Transportation. Decision to accept the lower figure was based upon three things:

1. The many "if's" involved in both estimates. (Possibility of extreme weather and its effect upon both consumption and transportation; possibility that railroads may not be able to continue present delivery pace during winter months; possibility that unforeseen emergencies may interrupt delivery or distribution, etc.)

2. It was decided that the application of a 33-1/3% cut during the milder months of the heating season might be more practical than to start with 25% and later have to cut a greater amount.

3. It was concluded the 33-1/3% cut would best equalize discomfort and stimulate fuel users to help themselves.

Questions concerning the probable availability of solid fuels brought confident predictions that in general, supplies will be adequate. Shortages of some grades were admitted, as well as temporary area shortages which, it was said, could be readily corrected.

Delegates attending the conference were also advised that OPA and WPB will work closely together in adjusting any conflicting rulings which may, now or later, impede the conversion program or otherwise interfere with the mutually agreed-upon goal of fuel oil conservation.

Building Cut Exempts Insulation

Typical of the workings of WPB and OPA when heat-conservation is involved is Revised Conservation Order L-41, which places a limit of $200 on private residential construction, unless specifically authorized, but exempts expenditures for insulation.

Other than this gesture toward insulation, there is little of an encouraging nature in the new Limitation order as far as the heating and ventilating industry is concerned. The revised order makes drastic cuts in the amount of civilian construction to be permitted without specific authorization. Following are the new

EDITOR'S NOTE: News from Washington and news on the fuel oil situation are inextricably interwoven this month. For further information on the fuel situation see page 61.

classes of construction established by the revision of L-41, with their former and present cost limits:

Type	Former Limit	Present Limit
Residential	$500	$200
Multiple Residential....	500	1000
Agricultural	1000	1000
Industrial	5000	5000
Certain types of commercial	5000	200
Other types of commercial, including highway, sub-surface and utilities construction.	5000	1000

Included among the types of commercial construction reduced from $5,000 to $200 are buildings designed for use as clubs, lodges, associations, fraternity or sorority houses, auditoriums or assembly halls. Also included are buildings designed for occupancy by not more than five establishments selling or dispensing goods, merchandise, food, or drink, or providing services. Large quantities of materials have been going into construction of such commercial structures under the provisions of the original order allowing up to $5000 to be spent during any continuous 12-month period.

Small Plants Setup Encouraging

If the L-41 revision and other tightening WPB restrictions seem to continually shrink the markets previously enjoyed by some branches of the heating and ventilating industries, some slight encouragement may be offered by the recent establishment of a Smaller War Plants Division within WPB, with Lou Holland at its head.

To date war production has centered largely in the hands of "big fellows", and all efforts to bring smaller plants into a bits-and-pieces program have bogged down.

Conversion to war work has been urged upon plants stymied by priority restrictions on the manufacture of civilian items, but efforts to secure war contracts have often proved discouraging. Initial efforts of Mr. Holland indicate that this situation may change.

It is the suggestion of HEATING AND VENTILATING'S Washington representative that operators of plants needing supplementary volume contact Mr. Holland's organization requesting inclusion in the new bits-and-pieces program. Communications should be addressed to Smaller War Plants Division, War Production Board, Washington, D. C.

Allwork Heads Heating Section

Ronald Allwork, assistant to W. Walter Timmis, who headed the WPB Plumbing and Heating branch until his recent resignation to enter the armed forces, is carrying on as Acting Chief of the branch.

Out of a maze of conservation orders designed to save scarce metals for munitions, the plumbing industry is feeling its way with numerous substitutes said to be proving highly satisfactory. Ceramic materials replacing metals in lavatories, sinks, closets and laundry trays have increased considerably in recent months.

While limitation of production has been one of the chief duties of the Plumbing and Heating branch, one of its most recent official actions *removes* a restriction. In Amendment No. 1 to General Limitation Order L-173, WPB removes restrictions previously placed on the production of gas unit heaters suitable for economical heating of war plants. L-173, issued August 5, curtailed production of domestic space heaters using fuel oil and gas.

A-C Section Still Curtailing

WPB's air conditioning and commercial refrigeration supervisors—with the unique distinction of having almost "limited" their own organization out of existence—released, on September 28, and amendment curtailing production of several additional refrigeration items. Amendment No. 4 to General Limitation Order L-38 prohibits further manufacture (except for government use) of the following additional items:

Ice cream cabinets not to be used aboard ship; Non-mechanical water coolers (whether of the iced bubbler or bottled type) having an ice capacity of less than 25 lb.; Evaporative coolers rated at 2000 cfm or less at the discharge side of the unit; Refrigerated display cases; Low temperature mechanical refrigerators having a net capacity of more than 8 cubic feet to be used for the freezing and storage of food on the farm.

Restrictions included in the new amendment to L-38 are in addition to the following, previously announced as on the restricted list:

Self-contained or remote control draft beer dispensers, including storage cabinets or water chilling devices, or both, which are a part of the dispensing system; Carbonated beverage dispensers; Bottled beverage coolers; Low temperature mechanical refrigerators having a net capacity of eight cubic feet or less designed for the storage of frozen foods; Self-contained air conditioners (room coolers) and window type air conditioners having a rated capacity of less than 2 hp or a capacity of less than two tons; Soda fountains without facilities for bulk ice cream storage; and florist boxes.

Although Amendment 4 prevents further manufacture of the items listed, and freezes manufacturers' stocks except for delivery to government agencies, sales from dealer or distributors' stocks are unrestricted. The single exception is the draft beer dispenser, which remains frozen.

Since its work consists largely of administering Limitation Orders, Air Conditioning and Commercial Refrigeration is currently handled through a Section of the General Industrial Equipment Branch of the War Production Board.

Sterling Smith acts as Chief of the Section, with the following as assistants: R. H. Tait, chief, emergency service unit; Leo Freitas, chief, refrigeration accessories unit; H. Forman, chief, commercial refrigeration unit; M. C. Terry, chief, air conditioning unit, and T. Quinn, chief of priorities unit. H. Stuart, W. Miley and F. Millham assist in the administration of Limitation Orders supervised by the Section.

To Strip Stores of A.C.

WPB plans for stripping department stores, hotels, office buildings

Ronald Allwork, acting chief of the Plumbing and Heating Branch of WPB. W. Walter Timmis resigned to enter the Armed Forces.

and theatres of all or part of their air conditioning equipment for use in war plants were disclosed Sept. 28 by Lessing J. Rosenwald, director of WPB's conservation division, as eleven department stores, including three of New York's largest, voluntarily agreed to surrender as much of their facilities as the government needed for war use.

Mr. Rosenwald made his announcement of WPB plans at a meeting in New York regional headquarters attended by representatives of twenty department stores located in cities north of Washington and east of St. Louis and Des Moines.

Stores represented at the meeting that did not offer their equipment indicated that it would be made available as soon as the situation could be explained to directors' meetings.

Air-cooling equipment taken over by the WPB will be put to work at once in war plants that cannot operate without such equipment, such as those making synthetic rubber and high octane gasoline.

In opening the meeting, Mr. Rosenwald read a letter from Donald Nelson, WPB chairman, which said:

"As you know, we are now building several plants, such as those which will manufacture synthetic rubber, where refrigerating equipment is a vital necessity to the manufacturing process itself. Tremendous quantities of compressors are needed, quantities larger than we could possibly build in the short space of time which is available to us for the prompt completion of these projects.

"In all probability it will be necessary to acquire existing equipment in sizes of 100 hp or larger from practically all stores, office buildings, theatres, hotels and buildings of like character. While we have requested only certain department stores' heads to attend this meeting, it is our intention to make similar requests of other users of refrigerating equipment, but we have deferred making such requests until we had the benefit of their advice and cooperation. This is the first group which has been called for this particular purpose. Others will follow."

Stores that volunteered their air-cooling equipment were Gimbel Brothers, R. H. Macy & Co. and James McCreery & Co. of New York; Famous Barr, St. Louis; Joseph Horne, Pittsburgh; J. L. Hudson Company, Detroit; Hutzler Brothers, Baltimore; The May Company, Cleveland; Sears, Roebuck & Co., Washington; Stix, Baer & Fuller, St. Louis, and Younker Brothers, Inc., Des Moines.

WPB is seeking three types of air-cooling equipment: compressors, condensers, and prime movers. The rest of the equipment will not be touched. The units needed will be purchased by the Defense Plant Corporation and resold to war plants.

Conversion Catechism

An elaborate explanation, in question-and-answer form, for publication by newspapers to guide house owners in their conversion problems, was issued by the plumbing and heating branch of WPB September 23. A similar list of questions and answers prepared by WPB for dealers and jobbers follows:

Q. I want to buy some grates, but my jobber will not sell them to me without a preference rating. What should I do? A. Sale of grates is not restricted, and no rating is necessary. Send us the name of your jobber, we will call him up and explain this to him.

Q. Can I use Order P-84 to get grates for conversion? A. No. You need no preference rating to buy these grates. P-84 is only to be used for replacement and repair purposes.

Q. I want to put a new boiler in to replace an oil burning type boiler that cannot be converted. They tell me I need a preference rating. Order L-79 says, "nothing in this order shall be construed to limit the sale or delivery of any equipment which is to be used for the purpose of converting oil burning equipment or gas burning equipment." Why, then, do I need a preference rating? A. The provision quoted refers to grate equipment, and similar items such as shaker bars and firing tools. It does not apply to the various items defined as new metal heating equipment.

Q. I am a wholesaler. If I sell my grate stock without ratings, how am I going to replace it? A. You may file a special Form PD-IX showing what ratings you have on grate stock for replacement and repair and showing the balance as grate oil conversion sales.

Q. I want to put a stoker on a job to convert from oil to coal. The stoker manufacturer tells me he needs a preference rating. I thought that stokers could be sold without preference ratings. A. If a stoker has a capacity of less than 60 lb per hour, a rating is not needed to get it. If over 60 lb, manufacturer has to have the rating of defense plants or others with high priority ratings to assemble it, and you will have to get your customer to file an application for a rating on a special Form PD-1A.

Q. I ordered some stokers from a manufacturer and gave him preference ratings. He tells me that he cannot ship the stokers because he does not have a high enough rating to get the fans. What can I do to get a higher rating? A. Give us the name of the stoker manufacturer, and we will get in touch with him about fans. Send data to operations section, plumbing and heating branch, railroad retirement building, Washington, D. C.

Q. I have lots of jobs signed up to put in grates for conversion purposes. I can get the grates, but I need some bolts, rivets, nuts, and pins to install them. What can I do about this? A. File a special application PD-1A, giving complete information relating to the planned conversions and send it to operations section, plumbing and heating branch, WPB.

Q. I am a jobber and can't buy an adequate supply of grates to take care of what the demand will be this winter. What should I do? A. You should file an appeal, addressed to the War Production Board, Washington. D. C. Show in the appeal that you need this equipment for anticipated conversion jobs.

Q. How about grates for fireplaces? A. Portable grates for fireplaces can be sold without a preference rating. However, their manufacture was prohibited September 3, 1942.

Q. How about damper control equipment for heating boilers and furnaces? A. Sale of these controls is unrestricted and there is available a considerable quantity.

Tenants and Conversion

Late in September, by a special amendment to its maximum rent regulations, the Office of Price Administration made it possible today for tenants and landlords to share the cost of converting oil-burning equipment to coal in the tenant's home. The same agency also provided that rent adjustments may be made, under certain conditions, to compensate landlords for insulating premises.

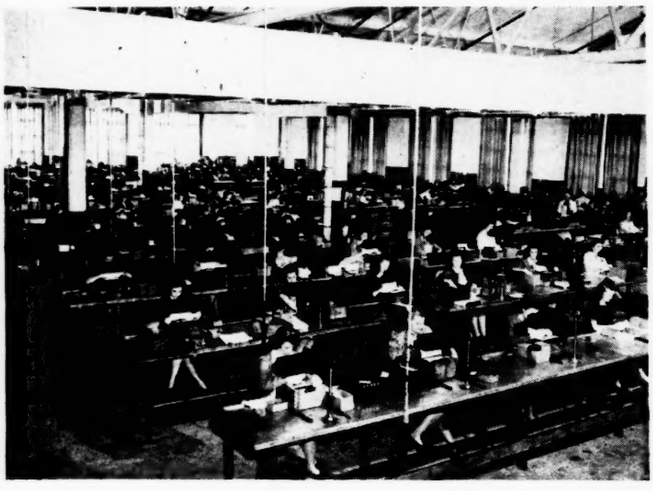
"Only because the fuel oil emergency demands that this important conservation step be taken wherever possible is OPA permitting this one exception to its maximum rent regulations," Paul A. Porter, deputy administrator in charge of the rent division, said. "The rent regulations specifically prohibit any agreement between tenant and landlord to a rent higher than the maximum legal rent."

To Register Dealers

All dealers in fuel oil (including peddlers) will be registered by OPA. Refiners in the rationed area and importers into the rationed area will be specially certified as "primary suppliers," and given a license number by the Washington office. Consumers who import in tank car or larger lots can qualify as "primary suppliers."

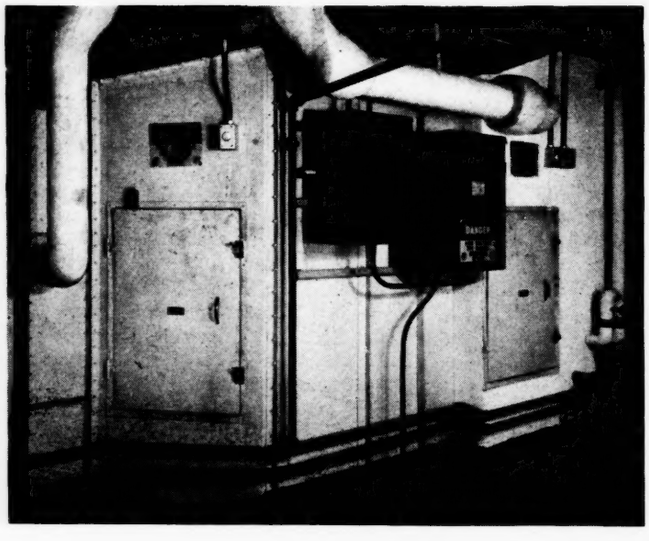
Picture Paragraphs

LARGEST SPRAY BOOTH in world designed and built by DeVilbiss for painting bombers. Booth is 152 ft long, 100 ft deep and 31 ft high, handles 496,000 cfm of air exhausted by sixteen 48-in. fans. Illustration shows one of the eight compartments making up complete booth. These compartments are assembled into pairs, side-by-side, with intervening 6 ft space between to accommodate 31 x 100 ft motor-driven partitions.

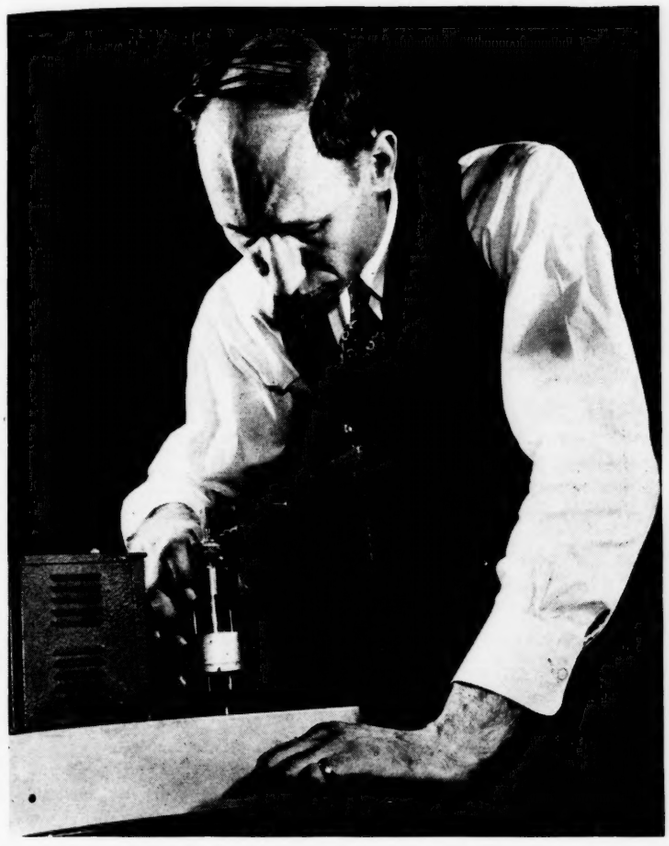


←

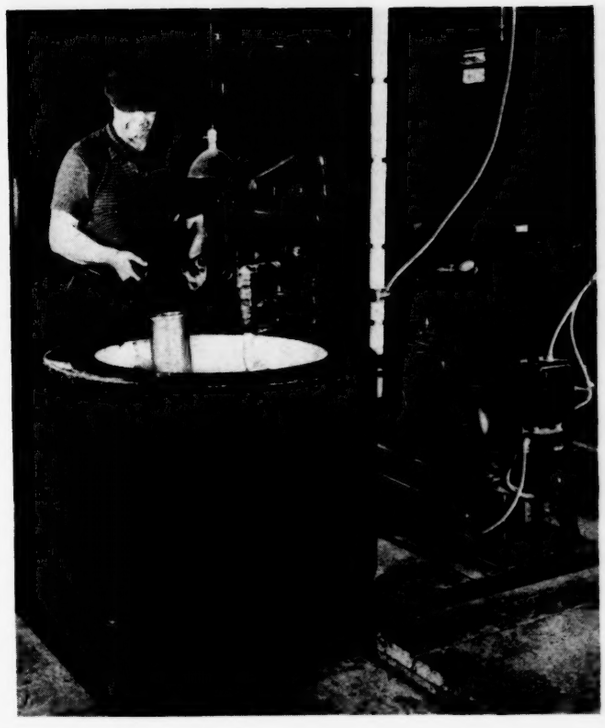
AIR CONDITIONED inspection room in the Atlas Ball Division of SKF Industries, Inc. Brightly polished ball and roller bearings are handled by girls wearing white gloves to protect the bearings from moisture.



PRECIPITRON FOR OPERATING ROOMS. A new 250-bed hospital in Washington is the first full-scale application of Westinghouse electrostatic precipitation. Unit has 24 cells with capacity of 18,200 cfm, is installed between heating coils and washer (above). View at right shows interior. Air is not recirculated. Air supplied to the operating rooms, which occupy three floors of one wing in the 10-story building, is cooled in summer by four 25-ton refrigerating compressors that serve other units of the hospital. Architect, Francisco and Jacobus, New York; air conditioning installed by Buensod-Stacey Air Conditioning, Inc., New York.



← **ELECTRONIC WEATHERMAN** automatically measures and records dew point of heat treating furnace gases to an accuracy of 1F. Device, invented by P. R. Kallischer, Westinghouse metallurgist, helps reduce spoilage of metal parts being treated. The device, of which the essential part is an electronic tube, indicates the exact moment when the furnace gases become too wet, by producing an unvarying electric current in an external wire circuit when gases are dry; current drops when water vapor in gas causes adhering of electrons to oxygen atoms in water. Meter is calibrated to indicate moisture depending on flow of current.



→ **—30F FOR CHILLING BUSHINGS.** Chilling of bronze castings before machining cuts machining time. This Carrier refrigerated tank holds a liquid of water and anti-freeze at —30F in a war plant. Extending the tolerance without sacrificing the precision, chilling process not only permits machining to be done in shorter time but also reduces the required seasoning time. Castings no longer need lie exposed to outdoor sun and cold for several months, but can be machined soon after they come from the mold when this chilling process is used.

← **SOLAR WATER HEATER** on Miami roof raises water temperature to 204F. At night, Celotex board insulation which lines the 30 in. x 50 in. x 3 in. deep tank reduces heat gain through the roof by day and heat loss at night. Ferox treatment prevents fungus. Heating element fits into tank and consists of a special annealed copper tubing upon which are soldered, in intimate contact, electrolytic copper heating fins which cover the whole floor of the case. Top of the case is covered with glass held in position by steel mullions.

The Post-War Housing Market

Both the Department of Commerce and the Producers Council, Inc., as well as numerous other groups, are keenly concerned with the housing situation following the war. The accompanying charts, and the description of what they mean, are but a part of and are abstracted from an excellent address on "The Post-War Construction Market" presented before the Producers Council in Detroit recently by S. Morris Livingston, Chief of the construction staff, Department of Commerce.

IN April, 1930, there were 23.2 million non-farm households, i.e., the census reported 23.2 million families occupying independent dwelling units. Converting owned homes to a rental equivalent at 1% of the value per month, their total annual rent was a little over $10 billion.

When the census was taken in April, 1940, a slightly smaller total income was divided among 27.7 million households. The total annual rent was slightly below $10 billion and, with the increase in households, the average rent was only about $29 per month as against $38 in 1930.

The effect of this change is illustrated in Fig. 1. In spite of a 20% increase in the total number of non-farm households there was a decrease of 20% in those occupying a dwelling at more than $40 per month. There was a correspondingly larger increase of 45% in those who could afford to pay $40 or less.

We have here a measure of the effective demand for housing on the two dates. It cuts across all of the hypothetical discussion of the kind of houses people ought to live in or would like to have. Most people figure that they can afford to spend about one-fifth of their budget, after taxes and savings, for housing. On the average and allowing for some inertia, this proportion seems to hold almost regardless of income level or of the quality of housing available at that price. With less income per household in 1940, the expenditures for housing declined in almost equal proportion.

The change in the shape of the curve indicates the shift in the effective demand for housing. It is not a measure of the actual deterioration of these structures over the decade. The four million dwellings with a rent or rental value of more than $40 in 1930 which had been handed down to a lower bracket by 1940* can be only partially accounted for by any reasonable depreciation and obsolescence, or by any change in construction costs. They must be explained by the excess of the 1930 supply over the 1940 demand in the higher brackets. Given this excess, competition forced prices and rents down to what people could afford to pay. Consumer income was the pattern for the curve. Competition forced the existing supply of housing into that mold.

This shift in the effective demand for housing was the dominant influence affecting new residential construction between 1930 and 1940. Throughout the decade there was an aggregate excess of supply over demand over most of the price range where new construction could compete with existing dwellings. This was not true for houses with a monthly rent or rental value of $40 or less. Hence, the pressure to construct very low cost housing. The fact that there was any construction at all in the price range over $40 must be explained by the lack of a homo-

*In spite of 2.7 million dwellings constructed during the decade, mostly in this price range, the total at the end of the period had decreased by 1.8 million.

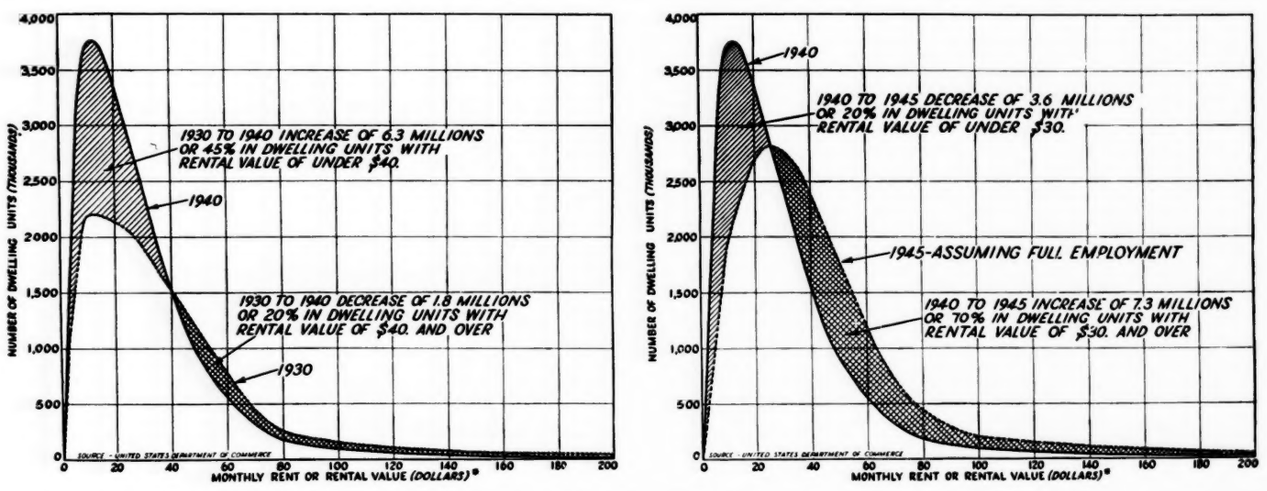

NUMBER OF DWELLING UNITS (THOUSANDS)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1930 TO 1940 INCREASE OF 6.3 MILLIONS OR 45% IN DWELLING UNITS WITH RENTAL VALUE OF UNDER $40.
1940
1930 TO 1940 DECREASE OF 1.8 MILLIONS OR 20% IN DWELLING UNITS WITH RENTAL VALUE OF $40. AND OVER
1930
SOURCE - UNITED STATES DEPARTMENT OF COMMERCE
0 20 40 60 80 100 120 140 160 180 200
MONTHLY RENT OR RENTAL VALUE (DOLLARS)*
1940
1940 TO 1945 DECREASE OF 3.6 MILLIONS OR 20% IN DWELLING UNITS WITH RENTAL VALUE OF UNDER $30.
1945-ASSUMING FULL EMPLOYMENT
1940 TO 1945 INCREASE OF 7.3 MILLIONS OR 70% IN DWELLING UNITS WITH RENTAL VALUE OF $30. AND OVER

Fig. 1. (Left) The housing market, 1930 and 1940, showing distribution of occupied non-farm dwelling units in the U. S. by rent or rental value. Fig. 2 (right) covers the same data but for the years 1940 and (estimated) 1945. The monthly rental value of owned homes assumed at 1% of total value. Reported value of owned homes adjusted for apparent bias.

geneous market. In spite of the aggregate oversupply of existing dwellings in the higher price classes, there were shortages in some places. Also there was the usual demand for custom-made dwellings to meet the requirements of particular families. There is always a market for some new houses regardless of the state of the second-hand market.

The 4.5 million additional households in 1940 were housed partly by this new construction, partly by absorption of the 1930 inventory of vacant dwellings and partly by use of shacks and trailers, conversion of existing structures to house more than one family, and similar expedients.

The increase in effective demand was all concentrated at the lower end of the scale. Since the demand for very cheap housing exceeded the supply, comparatively few dwellings were demolished. In other words, this shift in demand precluded the development of a large replacement market.

1945 and Full Employment

In analyzing the potential housing market which would exist with approximately full employment after the war, we have arbitrarily chosen the year 1945. It is near enough to be of immediate interest and to minimize possible errors in the estimates. At the same time it is far enough away so that we can hope the war will be over. The choice of another year would require some changes in the data but would not alter the fundamental conclusions.

By 1945 there will be about 31.5 million non-farm households. This allows for the marked effect of high incomes on family formation. It may not make sufficient allowances for war marriages but the possible error in the calculation is not great.

Total non-farm consumer income is already 45% above April, 1940. There is still some unemployment and the growth in both the size and productivity of the labor force will continue. Assuming full employment and the current 1942 price level, total income in 1945 could be about 60% above 1940. Most people do not expect that the 1942 price level will hold, but for the moment we can get a clearer picture of the outlook by making this assumption. Later we can modify our conclusions in the light of possible changes in the price level.

With a 60% increase in total income between 1940 and 1945 there may be a more than proportionate increase in both savings and taxes. We can assume that housing will maintain its usual proportion of all other expenditures. A 50% increase over 1940 would result in a total actual or imputed rent of about $15 billion at 1942 prices in 1945.

More important than the increase in total housing expenditures is the rise in income per family and the consequent shift of effective demand to the higher price classes. The average rent which declined from $38 to $29 per month between 1930 and 1942 would rise to $40 in 1945. The shape of the curve for 1945 as shown in Fig. 2 is derived partly from a study of the changes which occurred between 1930 and 1940 and partly from an analysis of those States which in 1930 and 1940 had family incomes above the average for the country as a whole.

The enormous market thus created can be measured by the areas between the two curves in Fig. 2. The demand for non-farm houses having a rental value of $30 or more would be 7 or 8 million dwelling units greater than in 1940. On the other hand, and in spite of the increase in the total number of families, the demand for dwellings with a rental of under $30 per month would be 3 to 4 million less than the number occupied in this price range in 1940.

The first effect of this demand would be to force a markup of the prices of existing structures. Even in a construction boom, the number of new dwellings built in a year is so small an addition to the total supply of houses that the market is determined largely by the demand relative to the existing supply. New construction could not possibly meet the demand fast enough to prevent people from bidding against each other for the older dwellings.

This reversal of the process which went on between 1930 and 1940 would be limited somewhat by inertia. It takes time for people to adjust their scale of expenditures in line with increased income. Also, there is a tendency to stay in the same home, particularly if it is an owned home, just because of the problems and difficulties of moving.

Citrus Fruit Concentrate is Refrigerated

The much-publicized citrus fruit concentrate being shipped to the allied nations abroad now has refrigerated storage space. The concentrate, one-eighth the weight of the original fruit juice, is first cooled to 90F by water and is further cooled in refrigerated rooms at approximately 35F for 48 to 60 hours to prevent aging. In one concentrate plant the daily production is 77,000 lb, is cooled in a large storage room, 128 x 34 x 8 feet, divided into four equal rooms, each able to store one day's production.

Refrigerating apparatus necessary are two Westinghouse 15 hp sealed compressors, one 20-ton evaporative condenser and four cooling units. One compressor is connected to the refrigeration units in rooms 1 and 3, and the other to rooms 2 and 4. The control is handled with room thermostats as follows: When cooling is required, the thermostat opens a solenoid valve, starts the evaporative condenser, the condenser pump and the compressor. The refrigeration unit blowers operate continuously.

Check Lists for Saving Oil

IT is imperative, particularly along the Eastern Seaboard, that every owner or operator of an oil burning heating plant carefully check the condition of his plant so that the proper steps can be taken, where necessary, to see that heat is produced economically, distributed and utilized efficiently, and finally conserved. The latter may involve insulation, storm windows, and weatherstripping.

The following check lists covering the *production* of heat by an oil burning heater and the *distribution* of this heat by different types of heating systems are abstracted by permission from the highly informative monthly publication *The Sinclair Firebox*, published by the Sinclair Refining Company in Chicago for distribution in its central district under the editorship of R. J. Bender.

HEAT PRODUCTION

1 Is the oil burner clean, particularly the strainer, nozzle tip, air inlet, fan wheel, and all air passages? It is recommended to have an oil filter installed in the fuel oil line.

2 In a pressure (gun) type burner is the nozzle tip of the right size, or has it become enlarged through years of wear?

3 In a rotary cup type burner, is the cup clean, its edges undamaged and does it "turn true"?

4 In a vaporizing burner, is the pot in good condition and clean?

5 Is the ignition system in perfect shape, ignition points unbroken, clean and in their correct relative position?

6 Is the combustion chamber, or the hearth in a rotary burner, satisfactory, without leaks, and of the shape and size deemed best by modern practice? If not it should be repaired and, if necessary, completely rebuilt.

7 Will a combustion baffle, above the combustion chamber or some baffling throughout the gas passages, reduce losses by directing the flow of gas more rationally?

8 Are the gas passages clean of soot? Removal of all soot with a steel brush and a vacuum cleaner is an essential step towards better fuel economy.

9 Likewise is there any considerable scale inside of the boiler? If so it should be removed and the water treated chemically to avoid further scale formation.

10 Are there any air leaks, around firing doors, cleanout doors, or inspection doors through holes (due to broken bolts, handles, hinges) or between boiler or furnace elements? These should be detected by means of a candle flame, and tightly patched.

11 Is the draft of the chimney correct and uniform? Is the chimney clean and in good physical condition? Is there an automatic draft control on the installation?

12 Does the sequence of operations as provided by the electric safety controls actually take place as intended, when the burner starts or stops or in case of any failure?

13 Is the fuel oil of good quality, clean and uniform? Are there any oil leaks between the storage tank and the burner? Is the tank ordinarily kept filled to avoid, as much as possible, condensation of moisture in the air?

14 Is there an ample supply of fresh air reaching the oil burner for proper combustion?

HEAT DISTRIBUTION

Warm Air System

1 Is the air properly distributed throughout the house, or do the dampers need some resetting better to balance the system?

2 Will a forced-air fan improve the circulation and the even distribution of the air? In that case the ducts and radiator grills should be measured and their sizes checked by a competent engineer to avoid disappointments. Also air filters should by all means be provided to protect the cleanliness of the home.

3 Are the air filters clean? If clogged with dust and dirt they are a definite source of waste, and should be either cleaned or replaced with new ones.

4 Are all the spaces around the air ducts, where they pass through floors or walls, tightly caulked to prevent dust from smudging up the walls?

5 Is there a sufficient intake of fresh air into the system, either through normal infiltration or by a small duct, with a damper, provided for that purpose?

6 Is the humidifier ample in size, functioning automatically, free from scale or salt deposits that would hamper its operation?

7 Is the electric fan control set correctly so that it will not cause cold air to circulate through the house, yet will keep air at a comfortable temperature, in steady circulation?

HOT WATER SYSTEM

1 Is the boiler large enough for intermittent oil-burner operation?

2 Does the hot water circulate rapidly and evenly throughout the entire house? If not, a forced-circulation pump is recommended. Electric controls should then be modified accordingly, so that the thermostat will control the operation of the pump, and an acquastat the operation of the oil burner. Setting the aquastat should be in line with the size and type of installation.

3 Are the water circulating pipes properly distributed throughout the house, or can some improvement be accomplished by separating the system into several zones, for quicker, easier circulation?

4 Are the radiators properly vented to prevent airpockets so fatal to correct heating? In some cases periodic venting is an absolute necessity, unless automatic air vents can be installed.

5 If any radiators in the house are to be shut off permanently or during certain periods, are the radiator valves tight? Inspection of these valves and, if necessary, regrinding of the seats, are advisable.

6 Should a humidifier be installed in certain rooms, fed by a small quantity of water from the heating system, either manually or automatically?

7 Is there an indirect hot water heater installed on the boiler, to supply economical domestic hot water, in summer as well as in winter?

STEAM OR VAPOR SYSTEM

1 Is the boiler large enough for intermittent oil-burner operation?

2 Is the pressure control set so that it will provide correct pressure for the steam to circulate evenly throughout the house? In a vapor system, does the gauge show evidence in winter that the system actually operates on vacuum for proper economy? If not, all piping and every valve should be checked for an air leak. Vapor-systems must be air tight for correct operation and maximum saving.

3 Is there an automatic low-water burner cut-off (with or without automatic feed-water system) to prevent an accident in case of inadvertent lack of water in the boiler?

4 Are the steam circulating pipes properly distributed throughout the building, or can some improvement be accomplished by separating the system into several zones, for quicker, easier heating, and are there sufficient water traps to avoid pockets and hammering?

5 Are all radiators equipped with air vents of the correct sizes, larger, for quicker venting on the radiators far away from the boiler, and smaller for slower venting, on those close by the boiler?

6 Are all the radiator valves steam-tight? Inspection of these valves and, if necessary, regrinding of the seats, are advisable.

7 Should a humidifier be installed in certain rooms, fed automatically by a small portion of the steam from the heating system?

8 Is there an indirect hot water heater installed on the boiler, to supply economical domestic hot water, in summer as well as in winter?

CONSERVATION

The following six-point check list, covering the conservation of the heat after its production and distribution, is suggested by J. W. Pauling, vice-president of Minneapolis-Honeywell Regulator Company and a member of the Plumbing and Heating Manufacturers Industry Advisory Committee of the War Production Board.

1 Prevent overheating and maintain uniform temperatures. Keep daytime temperatures to an even 68F and turn the thermostat down to 50F at night.

2 Turn off heat in unoccupied rooms (this includes bedrooms during the day). Keep shades drawn and keep windows closed at night.

3 Do not waste hot water.

4 Install storm windows and repair or close openings around doors and windows to effect complete insulation.

5 Replace missing boiler or furnace insulation. Insulate the hot water heater.

6 If in doubt, call your heating dealer and check your heating plant.

Study of a Conversion Grate for Oil Burning Plants

By R. C. CROSS

Senior Combustion Engineer, Technical Laboratories, Sears, Roebuck and Company, Chicago, Illinois.

Due to the seriousness of the fuel oil situation and the need for widespread conversion to coal, not only along the Eastern seaboard but perhaps in other sections of the country as well, any device tending to facilitate conversion is of timely interest. In this article the author describes a newly-developed grate, and shows how it can be used to advantage in the present fuel emergency.

THE shortage of oil, caused by war conditions, has created an emergency in the field of domestic heating in certain areas of this country where oil is widely used as a fuel. This is particularly true, at the moment, along the Eastern seaboard and, if present trends continue, it may well develop into a nation-wide situation. The serious nature of the problem is well recognized by governmental authorities, various industry groups, and individual manufacturers in the heating and fuel industries.

In the early spring of 1942, the Anthracite Industries Laboratory, one of the leading solid fuel research agencies, made an exhaustive study of the situation, reporting its findings in two comprehensive bulletins. These showed that approximately 50% of a total of 1,250,000 oil burning installations could be converted without complications.

Individual manufacturers of heating equipment have been fully cognizant of the situation and several have issued information related to their particular product. In addition, special conversion equipment has been developed to fit miscellaneous types and sizes of existing installations, the grate discussed in this article falling in this category.

Data presented in the Anthracite Industries' bulletins previously referred to indicate that there are approximately 425,000 oil burner installations where some form of replacement grate is needed. While the bulletin does not differentiate between horizontal rotary (internal wall flame), pot vaporizing, and pressure-atomizing (gun type) burners, it is probable that the majority are of the latter type.

The grate illustrated has been developed for the conversion of pressure-atomizing oil burner installations from oil to solid fuel at a minimum cost, retaining the advantages of existent thermostatic control, and utilizing the oil burner blower for forced draft while burning the solid fuel. This grate has the further advantage of permitting an easy changeover from oil to coal and vice versa.

Description of Grate

As shown in the photograph, the grate consists of two identical semi-circular castings of inter-locking construction. Means are provided for readily adapting the grate to the furnace dimensions of the conventional sizes of warm air furnaces and heating boilers. This is accomplished simply by using as many of the rings as required. An insert section, similar to a table leaf, is available for furnaces of rectangular shape. All component grate parts are readily inserted through the furnace firing door.

The installation of the grate is effected by constructing a suitable support, or base plate, around the existent oil burner combustion chamber at its top level. The conversion grate is placed upon this support, centrally located in relation to the oil burner combustion chamber, with the periphery, or outer ring, resting on the base plate and supporting the inner ring next to it. The ring assembly is of step construction with each ring supporting the adjacent inner one. The grate is fitted as closely as possible to the original furnace dimensions. A plenum chamber is thus formed below the grate and the

View of the conversion grate, showing semi-circular ring construction, making for easy adaptability to various sizes of boilers and furnaces. An insert section, similar to a table leaf, is available for furnaces of rectangular shape.

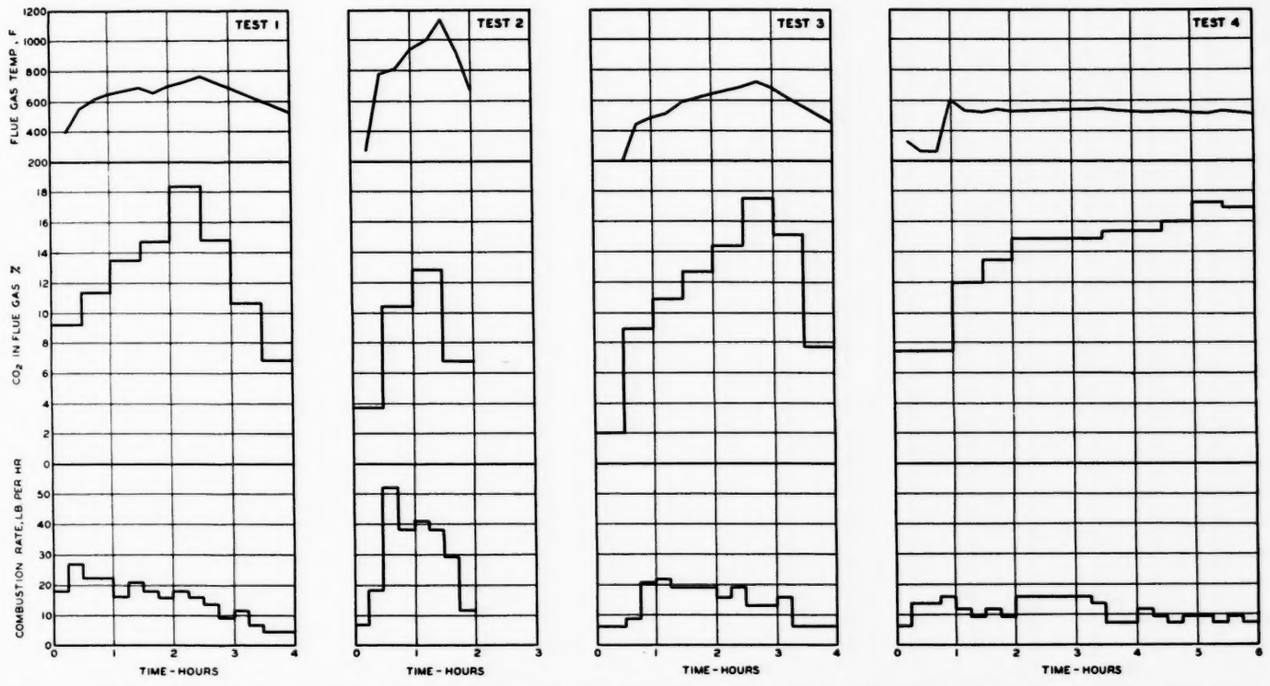


Fig. 1. (Left) Minimum capacity test, large fan operated continuously, fan shutter one-eighth open. Fig. 2. (Left center) Maximum capacity test, large fan operated continuously, fan shutter wide open. Fig. 3. (Right center) Minimum capacity test, small fan operated continuously, fan shutter wide open. Fig. 4. (Right) Minimum capacity test, small fan operated continuously, fan shutter one-eighth open.

provision of air holes, or tuyeres, well distributed over the grate, results in burning the fuel over the greater portion of the original grate area. The advantages of such operations are obvious, and are, notably, uniform distribution of burning, elimination of blow-torch effect and the ability to burn at the rate required by the heating plant demand.

Changes to Oil Burner

The changes required in the oil burner are quite simple. The nozzle and electrode assembly is removed from the draft tube, the oil line shut off and disconnected, and the oil pump shaft coupling disconnected. In most cases, changes in the electrical control circuit are easily effected. The burner stack-switch, or primary control, is removed from the stack, the ignition circuit is disconnected, and if required, a jumper wired across the heater coil of the safety switch.

Operation and Installation

The results obtained with this grate will depend largely upon the operating methods of the user and the particular conditions of the installation.

Best operation is attained by utilizing the conical method of firing. It is essential that a generous bright spot of red coals be left around the outer edge of the fuel bed. The secondary air slot, or shutter, should be left a quarter or half open at all times. If this practice is followed, a uniform fuel bed will be obtained and puffs or blow backs, due to the sudden ignition of the gases, will be avoided.

The characteristics of the oil burner fan, in each case, will have an important bearing upon the results. Normally, the fan will be of ample capacity to furnish the required *amount* of air, as this factor is related to the rate of heat release, and is not dependent upon the type of fuel. Oil burner fans, however, ordinarily operate against a much lower resistance than that imposed by a bed of solid fuel. In some instances, the permissible depth of fuel bed, and amount of fuel fired, will be limited by this fan characteristic. The grate under discussion is designed with a maximum free air opening so as to reduce the resistance it offers to the oil burner fan.

Care should be taken in each installation to seal the space between the outer edge of the grate and the furnace walls. This will prevent leakage of excess air, and insure better performance. All cracks, or openings from the oil burner combustion chamber also should be sealed.

It is expected that the principal fuel used with this grate in the Eastern seaboard area will be the small sizes of anthracite. A preliminary laboratory investigation was conducted using No. 1 buckwheat anthracite.

Test Set-Up

The grate and oil burner were assembled in a conventional 24 in. diameter cast iron warm air furnace and the entire assembly mounted on scales. In this manner, the weight of combustible burned could be accounted for in any desired increment of the test period. Suitable instruments were used for measuring and recording overfire draft, smokehood draft, pressure under grate, flue gas temperature, and flue gas analysis.

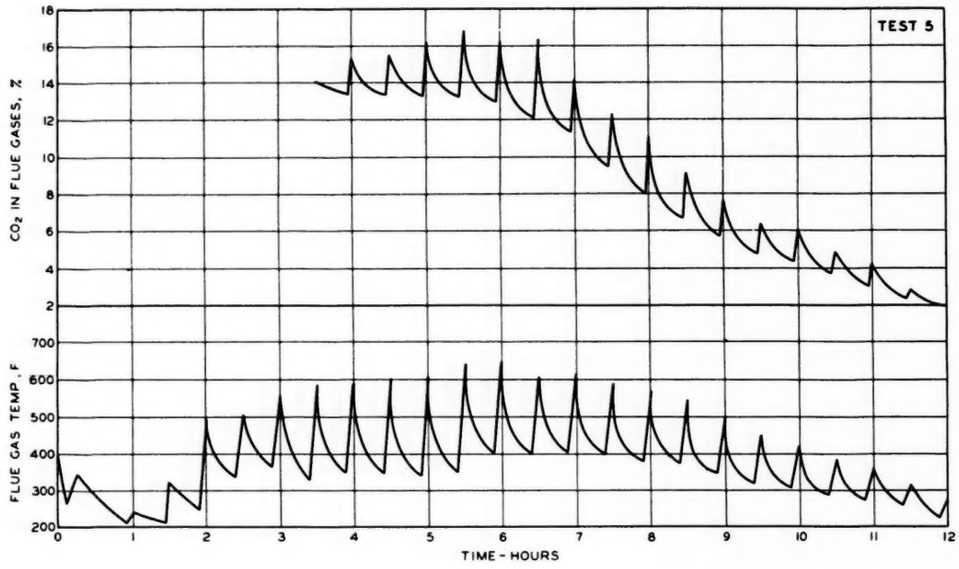


Fig. 5. Intermittent operation, large fan running two minutes out of each 30 minutes, fan shutter one-eighth open.

In order to determine the effect of burner fan characteristics, two sizes of oil burners were used. The large burner had a rating of from 1.6 to 3.5 gal of oil per hour, and had a forward curve multiblade fan wheel 6 in. in diameter and 3½ in. wide. The small burner had a rating of from 0.75 to 1.3 gal of oil per hour, and a similar type wheel of 5 in. in diameter, 2¾ in. wide. All tests were run with the overfire draft maintained at .05 in. of water and with the secondary air opening closed.

In actual usage, the rate of burning during the blower *on* periods will be controlled by the setting of the blower air inlet opening. Experience will teach the user the proper settings to be made to meet varying loads upon the heating system imposed by changing weather conditions.

Tests conducted in the laboratory were of three general types: (1) continuous tests to determine maximum and minimum capacities of fuel burning rate, (2) intermittent tests simulating possible field operation, and (3) a banking test with natural draft operation.

Capacity Tests

The results of the capacity tests are presented in Table 1 and graphical logs of operation are shown in Figs. 1 to 7 inclusive. Fig. 1 represents a practical minimum test for this grate. The large oil burner fan was used, with the air shutter one-eighth open and the fan running continuously. A lower rate of burning could have been obtained if the fan shutter had been completely closed and air supplied by leakage only. The average coal burning rate was 16.55 lb per hr to 1.51 gal of oil per hr as compared to the burner minimum rating of 1.6 gal.

In this test as, in fact, in all of the tests, the carbon monoxide in the flue gases was high because of the lack of secondary air and the small amount of excess air.

Fig. 2 represents the maximum rate obtainable with this grate and the large oil burner fan. The fan shutter was wide open and the fan operated continuously. The average weight of coal burned for the entire test period was 30.3 lb per hr, equiv-

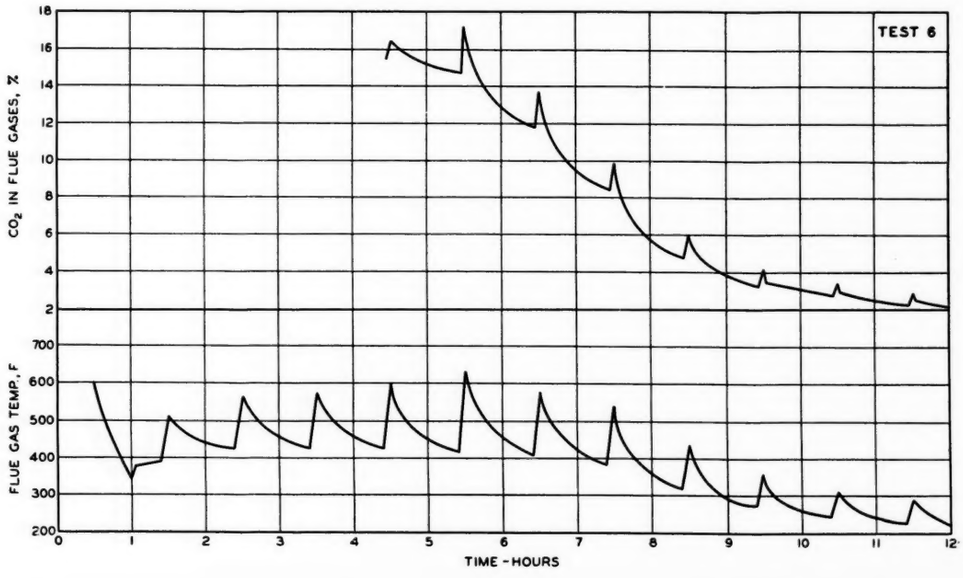


Fig. 6. Intermittent operation, large fan running one minute out of each hour, fan shutter one-eighth open.

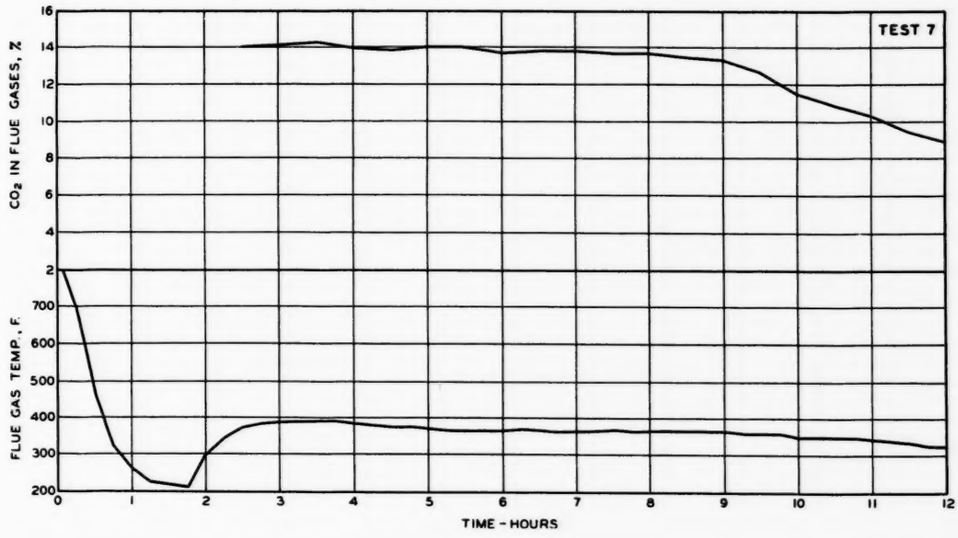


Fig. 7. Banking test. Shutter of large fan one-eighth open, fan idle, natural draft.

alent to 2.77 gal of oil per hr, somewhat below the rated burner capacity of 3.5 gal per hr. Reference to Fig. 2 shows momentary rates of burning far in excess of this amount, indicating that in normal intermittent operation the grate will not be deficient in supplying the necessary pickup factor. This is particularly true in the early period of a fresh charge of fuel.

Figs. 3 and 4, giving charted results of tests conducted with the smaller burner, show results relatively similar to those for the large burner. The particular furnace utilized in these tests has a rating of 76,300 Btu per hour. Heat balance tests, not reported here, indicated an overall efficiency with the grate of approximately 50%. The required heat release for furnace rating could be readily obtained with the small burner, fan shutter full open.

Intermittent Tests

Intermittent tests, simulating cold weather and mild weather operation, were conducted. Fig. 5 shows the results of a test run with the oil burner fan operating by timer control 2 minutes out of each 30 minutes. Fig. 6 covers a test in which the timer setting was one minute per hour.

The principal points of interest in these two tests are: the immediate response of the fire to blower operation, and the length of period before recharging of fuel would be required. Fig. 5 indicated a firing period of approximately 12 hours, while in Test 6 (Fig. 6) it was found that a charge of fuel would last approximately 14 hours.

The above intermittent tests were run with the large burner, fan shutter one-eighth open.

TABLE 1.—MAXIMUM AND MINIMUM CAPACITY TEST DATA
(Blower Running Continuously)

Item No.	Description	Large Oil Burner		Small Oil Burner	
		Min.	Max.	Max.	Min.
		Test 1	Test 2	Test 3	Test 4
1.	Position of fan shutter	1/8 open	wide open	wide open	1/8 open
2.	Length of test, hr	3.66	1.92	4.92	5.92
3.	Smokehood draft, in. of water	.083	.117	.082	.08
4.	Overfire draft, in. of water	.051	.051	.05	.05
5.	Pressure under grate, in. of water	.08	.30	.065	.08
6.	Pressure drop through grate and fuel bed, in. of water	0.131	0.351	0.115	0.13
7.	CO_2 in flue gas, %	13.2	8.4	10.4	13.5
8.	O_2 in flue gas, %	1.3	7.2	7.0	3.3
9.	CO in flue gas, %	2.0	4.2	2.6	3.7
10.	N in flue gas, %	83.5	80.2	80.0	79.5
11.	Excess air, %	1.4	31.8	37.0	8.1
12.	Temperature of flue gas at smokehood, F	643	822	538	482
13.	Total weight loss during test period, lb	54.0	52.0	55.5	51.5
14.	Equivalent fuel burned during test period, lb	60.6	58.3	62.3	57.8
15.	Coal consumption, lb per hr	16.55	30.3	12.65	9.76
16.	Coal consumption, lb per hr per sq ft grate	6.9	12.65	5.28	4.06
17.	Heat release rate, Btu per hr	213,614	390,264	162,932	125,709
18.	Equivalent oil rate, gal per hr (141,000 Btu per gal)	1.51	2.77	1.15	0.89
19.	Manufacturer's rating for oil burner, gal per hr	1.6	3.5	....	....

Kind of fuel: Anthracite No. 6 DL&W, Buckwheat No. 1. Proximate analysis, as fired, %: Moisture 1.5, volatile matter 4.1, fixed carbon 83.6, ash 10.8. Calorific value, 12,880 Btu per lb.

Size of multiblade wheel: large blower, 6 in. dia x 3½ in. wide; small blower, 5 in. dia x 2¾ in. wide.

Banking Test

Fig. 7 shows the results of a banking test conducted with natural draft. The large burner was used, with the fan shutter one-eighth open, blower not operated. Features of this test are the long period of uniform heat release with exceptionally good combustion, and the long period between fuel charges. Apparently one charge would last about 16 hrs.

The average smokehood draft in this test was .07 in. of water, and the overfire draft .05 in. of water. Where the natural draft conditions in the field are of this order, banking periods with natural draft operation will be practical. In some installations, however, timer controlled blower operation, similar to conventional stoker *hold-fire* operation, may be required.

Ash Removal

A point of interest in the use of this grate is the accumulation and removal of ash. A special ash removal spoon and clinker tongs are provided. No difficulty was experienced in removing the ash and refuse above the grate.

It was expected that a certain amount of fine ash would fall through the grate openings into the oil burner combustion chamber. After burning 607 lb of coal the chamber was cleaned. The ash and refuse removed weighed 5 lb, less than 1% of coal fired.

In normal installation, a small access door is provided for removal of ash in the oil burner combustion chamber wall. An alternate means of access is the temporary removal of the burner wind tube from the combustion chamber wall.

Use with Other Fuels

Because of the widespread use of the smaller sizes of anthracite along the Eastern seaboard, the laboratory tests were conducted with No. 1 buckwheat anthracite. It may be desirable, in many installations where poor draft conditions are found, to use larger sizes of this fuel.

There is no reason to believe that the grate will not perform satisfactorily for other fuels. Some difficulties may be encountered with high ash, low ash fusion bituminous coals, coals that cake strongly, and the like. These factors will increase the attendance required, but when it is remembered that the grate is intended mainly as emergency equipment and that it will provide a means of obtaining warmth in the home, a certain amount of inconvenience may seem of small consequence.

Conclusions

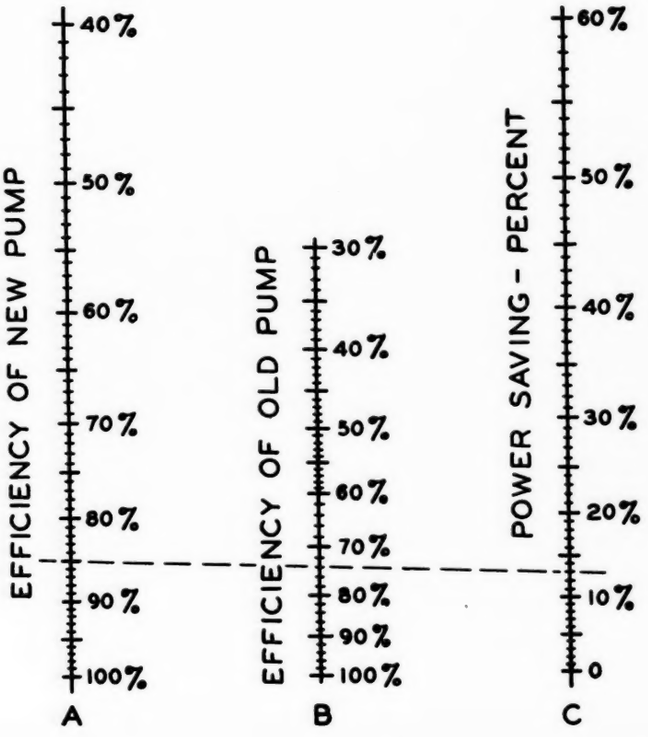
The tests conducted indicate that this grate represents a practical method of converting pressure-atomizing oil burners to the use of solid fuels. Although the conditions of individual installation have an important bearing upon the results, the grate, when properly installed and operated, permits the efficient burning of solid fuels at rates required to supply the demands of the heating system.

The grate is not claimed to be the ultimate in fuel burning equipment, but for the intended emergency period usage, it fills a definite need in the present situation.

Comparing Pump Efficiencies

If the efficiency of your present pump is 74%, and you are planning to install a new pump whose efficiency will be about 85%, the improvement will not be merely 11%. There will be an improvement of 13% in efficiency.

The accompanying chart gives the true improvement or power saving without any longhand figuring whatever. Simply run a straight line through the efficiency of the new pump, Column A, and the efficiency of the old pump, Column B, and the power saving or improvement in efficiency is found in Column C. Thus the dotted line drawn across this chart shows that if the efficiency of the new pump is 85% and that of the old pump is 74%, the improvement, or power saving, is 13%.—*W. F. Schaphorst.*



(Right) Nomogram for determining power savings effected by improving pump efficiencies

FUEL SITUATION

Fuel Oil Rationing Includes Midwest; Areas Zoned by Degree Day Normals; Rationing to Affect 3,000,000 Houses

Coupon rationing of fuel oil in 30 eastern and midwestern states and the District of Columbia will begin about October 15, but will cover all oil used after October 1, Price Administrator Leon Henderson announced Sept. 17. The program will be initiated as soon as necessary forms and coupon books can be printed and distributed, he said, warning bluntly that the prospect of uncomfortably cold homes this winter confronts residents of the rationed area who depend on oil for heating. The affected area comprises more than a third of the country and contains almost three-fourths of the nation's population.

The amount of oil to be allowed each heating unit under the plan, intended to cut consumption 33-1/3% in the affected area, will be based on several factors, chief among them being floor space in the house and the amount of fuel used last year.

Householders, to get coupon ration sheets, will be required to furnish local rationing boards with detailed information about characteristics of the dwelling and furnace. This will be done through use of an application form during a special registration period, dates of which will be announced later.

Employing a formula worked out by the OPA in consultation with the heating industry, local rationing boards will determine the number of gallons of fuel oil to maintain daytime temperature of 65F under average weather conditions. Adjustments then will be made on the basis of past consumption.

If poor insulation and poor oil burner efficiency make it impossible to maintain the 65F temperature with this amount of oil, the householder is expected to cut down the heat loss rather than burn more fuel.

EDITOR'S NOTE: Fuel oil rationing plans described on these pages are those as announced by OPA September 26, and may be subject to changes. For additional information on the fuel oil situation plans, see Washington News, page 47.

Zoning

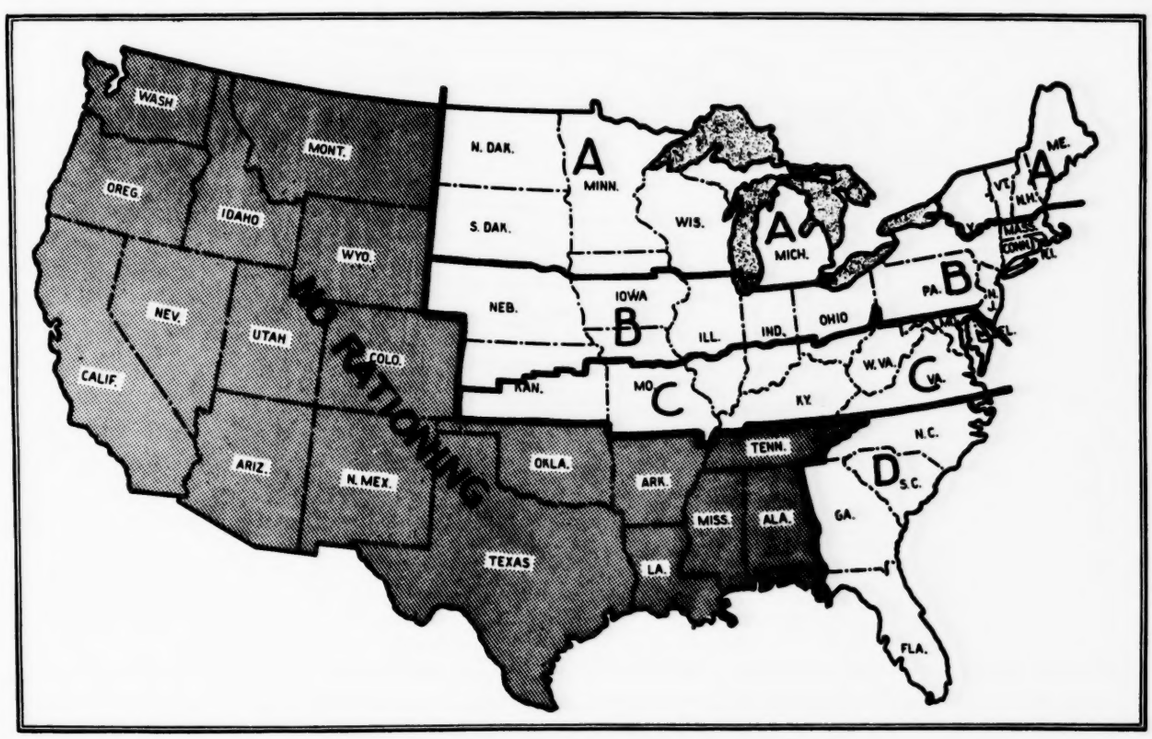
The rationing plan will cover 30 states, including sections of the midwest where, WPB announced, fuel oil supplies have dwindled due to diversion of transportation equipment to aid the east. Disparity in climate throughout the different zones will be provided for by using degree-day data, OPA reported. The zones themselves are not boundaried according to degree-days, however, but sub-zones will be so outlined.

The four major zones are as shown on the map below.

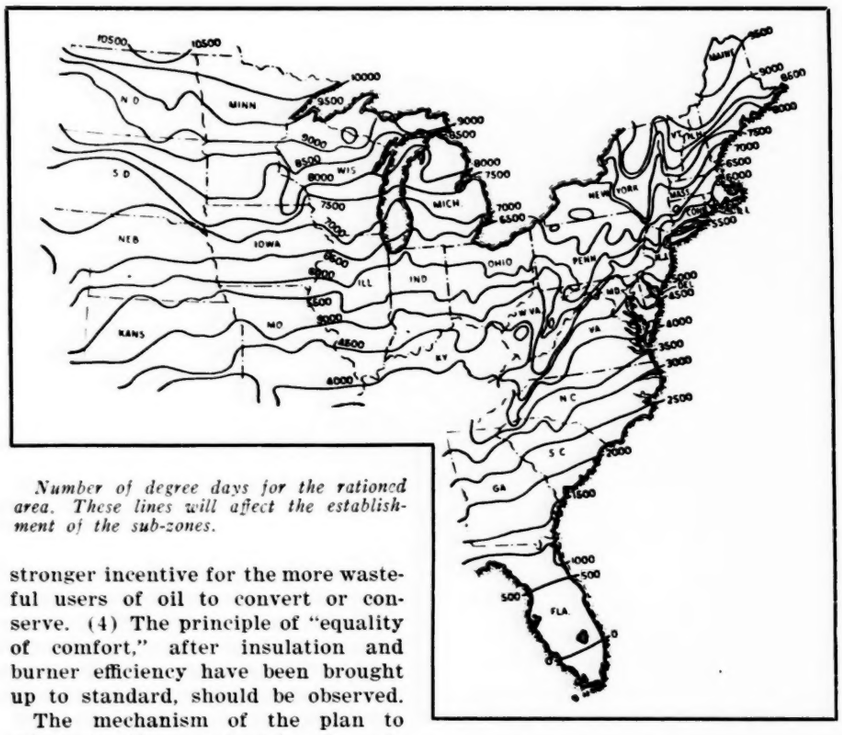
OPA has established various types of consumptions including various sub-types of space heating uses; water heating; and other uses. These are outlined in some detail in the following abstracts from OPA's plan.

Space Heating Uses

Certain well accepted principles are an essential foundation for a heating oil rationing plan. Within the limits of practicality a rationing program should allocate fuel oil in consonance with the following principles: (1) The quantity of fuel oil allocated under the rationing system must not exceed the total quantity available; (2) The maintenance of minimum healthful temperatures in various situations should be an important goal. (3) A stimulus should be provided to conserve oil by conversion to coal or wood, by improving the efficiency of oil burners, and by reducing structural heat loss. So far as practical, this stimulus should be differential in order to provide a



Thermal zones established by OPA for fuel oil rationing.



Number of degree days for the rationed area. These lines will affect the establishment of the sub-zones.

stronger incentive for the more wasteful users of oil to convert or conserve. (4) The principle of "equality of comfort," after insulation and burner efficiency have been brought up to standard, should be observed.

The mechanism of the plan to effectuate these principles is substantially the same for all heating uses of oil by all types of consumers.

Thermal Zones

To provide for disparity of climatic conditions throughout the rationed area, the area will be divided into thermal zones. Within each thermal zone the pattern of distribution of degree days throughout the heating season is similar.

Similar treatment will, therefore, be accorded to all users of heating oils within a single thermal zone, and adjustments will be made for differences in weather conditions among zones. The division into thermal zones will also make possible varying percentage cuts of oil in different zones to accomplish the same reduction of internal temperature in each. Although this technique provides for broad variations between zones, the plan also takes account of degree day variations among individual localities within zones. Coupons for purchase of oil for heating purposes will be differentiated by color for each of the four thermal zones. This will permit the assignment of different gallonage values to the coupons in different zones and provide flexibility in meeting unusual weather or supply situations in each zone. The thermal zones will extend the entire width of the rationed area.

Periods

The heating season for each zone will be divided into five periods of approximately equal degree days, which means that the periods are similar in respect to fuel needs. The season's ration of fuel oil will thus be allocated equally by heating periods. The states included in each zone and period expiration dates are as follows:

Zone	Tentative Expiration Date
PERIOD 1	
A	Nov. 29
B	Dec. 2
C	Dec. 3
D	Dec. 5
PERIOD 2	
A	Jan. 6
B	Jan. 5
C	Jan. 4
D	Jan. 2
PERIOD 3	
A	Feb. 8
B	Feb. 6
C	Feb. 2
D	Feb. 5
PERIOD 4	
A	Mar. 17
B	Mar. 12
C	Mar. 6
D	Mar. 6
PERIOD 5	
All Zones	Sept. 30

The coupons for space and water heating will be numbered from one to five to identify them with the five periods. The Coupons for each Period will become invalid after the expiration date of the Period, with the exception of a provision for advanced and delayed use which is to be described later.

Indefinite Value Coupons

Rations for all space heating purposes will have indefinite value coupons. These coupons will be expressed in terms of units. They will have two denominations—a one-unit size (OPA-R-1105), and a ten-unit size (OPA-R-1106). The coupons will specify on their face the zone to which they apply, the number of units they represent, and the heating period for which they are valid. The use of indefinite value coupons makes it possible to periodically adjust the gallonage value for changes in supply and weather conditions. The use of periods and zones increases the effectiveness and equity of these adjustments. Thus, if period 1 in zone A is unusually cold, the unit value of coupons for period 2 in that zone will be increased to make up for the unusual fuel requirements. The advantages of this "post mortem" adjustment is that value change can be based upon historic temperature facts rather than upon future weather conjectures.

It is anticipated that the inital value of each unit for the first period in every zone will be ten gallons. The indefinite value coupons are known as V rations in response to popular suggestion. Both types of sheets contain one hundred indefinite value coupons and a group of fixed value coupons for change-making purposes.

Basic Rations, Houses

A private dwelling is defined as a building or structure designed for the occupancy of fewer than four families in which seventy per cent or more of the total floor space is used for residential purposes. The term does not include a boarding or rooming house in which four or more rooms are regularly rented or available for rental.

A basic ration will be determined for the entire heating season. This ration will be determined in accordance with the previously mentioned rationing principles, within the limits of practical administration.

The basic ration for heating private homes will be determined by two criteria: (a) A fuel-requirements formula which is based on the floor area of the home, the temperature of the locality, and a constant which reflects heat loss from a standard home. This formula will set the ration range as described later. (b) A percentage of past consumption adjusted to normal weather conditions will determine the ration if the applicant falls within the range. Users who fall below the lower limits of the formula range are unusually efficient. They will be cut less deeply but they will under no circumstances receive more than 85 per cent of last

year's consumption adjusted to normal. The formula which expresses fuel requirements of a typical free-standing house of average construction and average burner efficiency modified by the normal temperature of the particular area is $F = \frac{AD}{K}$, where F is the fuel requirements, A floor area, D is the normal degree days at that locality, and K is a constant determined through empirical tests to be the standard of thermal efficiency. This formula gives the total number of gallons of fuel oil required for the structure. Since there are a number of factors affecting fuel requirements of homes other than those taken account of here (such as exposures; type of construction, location, insulation and quality of workmanship) OPA has assumed that K (the denominator in this formula) can vary for different individuals over a range from 3,750 to 5,000 without proving significant deviations from reasonable or standard efficiency. When the denominator for a given dwelling is under 3,750, however, the building is probably operating below standard efficiency and there may be a number of heat loss factors which can be corrected by the owner. At this point it becomes necessary to penalize the wasteful user.

The plan states that no home shall receive more than D/3750 gallons per square foot of floor area. This is the upper limit of the range. The farther the home lies above the upper limit, as OPA has defined it, the greater becomes the cut in the fuel oil allowance under what this dwelling has normally burned. At the other end of the range fall the many owners who have insulated their homes, adjusted their burners or otherwise saved fuel during the past year and therefore use a small amount of fuel oil per square foot of floor area. Thus, those who use less than D/5000 gallons of fuel oil per square foot of floor area (or the lower limit of the range) are defined as the more efficient users and they will have, therefore, a less severe cut as a compensation for their efficiency.

The formula is designed to bring the room temperature of the standard home to a uniform temperature throughout the rationed area. The degree drop in temperature will depend upon the extent of the fuel oil shortage. Presumably, the standard temperature will not be less than sixty-five degrees, which has been determined as the minimum health standard. The least efficient users should be able to effect the greatest fuel savings by conservation measures and the average users can also reduce their needs considerably. It is anticipated, therefore, that all consumers will be brought to somewhat the same level of consumption as the efficient users. Some of those who have been most severely cut are those who should convert to coal, since they will not get supplemental rations if they are able to convert.

An appreciable saving may be made by this process. Information about floor space will be obtained from the consumer's affidavit on his application blank and can easily be checked.

The other determinant of the base ration will be a percentage of past consumption adjusted to normal temperature. The applicant's purchases over the past season must be certified by his dealer or dealers. Each thermal zone has been subdivided into a number of sub-zones (having a range of approximately 500 degree days) and normal degree days are established for each. The consumer's ration will be accurately adjusted to the temperature in his locality by relating his ration to the degree days in his sub-zone.

Other Buildings

A multiple dwelling is a building or structure designed for the occupancy of more than three families in which seventy per cent or more of the total floor space is used for residential purposes. The term includes hotels, boarding or rooming houses in which more than three rooms are regularly rented or are available for rental.

It is practical and equitable to include multiple dwellings in the same classification as commercial, institutional and industrial establishments, and to use the same method for determining their rations. Since all of these categories are diversified in heating needs and since they occupy a great variety of structures, it is not practical at this time to use formulas. Basic rations for these uses will, therefore, be determined by a percentage of past consumption adjusted to normal temperature.

When information on past consumption is not available, a certificate by a qualified heating engineer or architect as to the normal fuel requirements of the establishment will be required. The percentage cut will then be applied to the normal requirements recorded in this certificate. In exceptional cases where a health hazard is involved, such as hospitals, supplemental rations will be allowed. In all cases, a uniform percentage curtailment will be applied based on the assumption that temperature differentials existed in the past for economic reasons and are necessary, practical and equitable.

Past consumption offers a fairly reliable estimate of fuel requirements for these types of uses because it takes into account the many peculiarities of each building, such as wind exposure, amount of ventilation and hours of occupancy. The latter factor, in particular, is difficult to work into a formula.

Water Heating

Before the domestic heating ration is calculated, it is necessary to remove past consumption of fuel oil for heating water, because the fuel requirements formula applies only to space heating. For administrative ease and to simplify the local board procedure, a formula has been developed for calculating normal fuel requirements for water heating. This is a function of the number of persons in the home. The margin of error resulting from the use of this formula is small, as proved by experimental tests.

After the space heating ration has been determined, the water ration is added thereto. This will be the amount deducted from past consumption reduced by the same percentage as the cut in the average heating ration. The applicant is thus given a water ration in indefinite value coupons. There is a slight inaccuracy here because the water requirements do not vary seasonly as do heating requirements. The error is unimportant, OPA says, because the consumer's tank has ample capacity to absorb the difference. This ration will be allowed for only the period during which oil is used to heat water in the following twelve-month period.

Commercial and industrial users of oil for heating water will receive the same percentage limitation of normal requirements as will be applied to space heating consumption. This will enable the ration boards to compute a uniform percentage cut on the building's total oil consumption for a normal year.

Auxiliary Rations

In cases of extreme hardship, supplemental rations will be provided by the ration boards, but proof of need must be offered. The following cases will be covered by the auxiliary application:

(A) Age and Sickness eligibility for additional allowances of fuel oil will be determined by the local board on presentation of a doctor's certificate that additional heat is required for sickness or for old age. Additional safeguards will be provided by a specific statement in the doctor's certificate, a careful restriction of the time period, and review by a public health official.

(B) Persons who can prove physical, or financial inability to bring the dwelling or burner up to the

assumed standard of insulation or burner efficiency, and impossibility of making adjustments such as the closing off of rooms, may be eligible for additional rations. Applications for supplemental rations on grounds of insulation and burner inefficiency will require certification by a responsible housing authority.

If the applicant for a supplemental ration can reasonably be expected (as defined by the regulations) to convert his heating plant to coal, he will be denied a supplemental ration.

(C) Persons who live in inaccessible areas may be permitted to use the coupons of more than one ration Period by special permission from the Ration Board. The purchaser assumes the risk of subsequent revaluation of the coupon.

(D) Persons injured by mistakes of the ration board or by the supplier will receive adjustments.

(E) Restitution will be made for leakage from consumer's tanks and equipment when certified by a technician.

(F) Situations involving health or sanitation may supply grounds for supplemental allowances. One category in this group is the hospital. Hospitals will receive a percentage cut over past consumption in the same way as other commercial or institutional enterprises. They will have the privilege, however, of obtaining supplemental rations to the full extent of their needs for hospital space only. It is the intention of the plan to allow hospital space as much heat as the authorities deem essential. The same considerations will apply to sanatoriums.

Restaurants that have unusually large hot water requirements will receive supplemental allowances when proof is presented that the additional ration is needed for sanitary purposes.

(G) Consumers who fail to fill tanks for good cause prior to October 1 may receive a compensatory auxiliary ration.

Other Government Moves

Meantime other developments included (1) a decision by Home Owners Loan Corporation to convert 2000 of its houses from oil to coal, so as to secure maximum protection of its home investments and to help the families living in HOLC-owned homes protect themselves against the fuel oil shortage.

(2) Restrictions on production of gas unit heaters, adaptable for economical heating of war plants, were removed September 19 by WPB. In an amendment (No. 1) to General Limitation Order L-173, WPB excepted from provisions of the order the production limitations previously imposed on gas unit heaters.

(3) The Census Bureau reported that, based on 1940 Census figures, oil rationing would affect over 3,000,000 homes. Insofar as single-family houses are concerned, the Bureau stated that in 1940, in the rationed area, New York state had 652,820 oil heated houses, or 18.6% of all its single houses. Corresponding figures for some other states, from the Census, follow: Rhode Island, 84,986 or 45.8%; New Jersey, 264,924 and 24.7%; Connecticut, 182,844 and 42%; Delaware, 16,291 or 23.5%; District of Columbia, 33,998 and 23%; Florida, 107,344 and 21.7%; Georgia, 10,078 and 1.4%; Maine, 35,233 and 16.5%; Maryland, 108,688 and 24%; Massachusetts, 400,596 and 36.9%; New Hampshire, 36,273 and 28%; North Carolina, 23,946 and 3.1%; South Carolina, 18,951 and 4.5%; Vermont, 14,020 and 15.5%; Virginia, 48,650 and 7.9%; West Virginia, 634 and 0.1%.

ASHVE Active in N.Y.

The ASHVE's War Service Committee has published an 8-page pamphlet on War on Fuel Waste—How to Do It. This pamphlet is reviewed on page 66.

Mayor F. H. LaGuardia of New York City announced in his weekly radio "Talk to the People" on Sept. 13 that he had appointed a committee to aid owners of one and two family houses in obtaining low cost expert advice on all matters relating to fuel conservation and the conversion of oil burners into coal burning equipment, and that these services could be gotten through the Mayor's Engineering Advisory Committee, Box 72, Madison Square Station, New York.

If, in the Committee's opinion, answers to inquiries are covered in its pamphlet, War on Fuel Waste—How to Do It, the pamphlet will be mailed free of charge in a self-addressed envelope. If a more detailed answer is necessary, a printed questionnaire will be sent to the applicant requesting him to fill it out and return it with a nominal fee of $2. Later, the house owner will receive a reply based on the facts supplied in the questionnaire.

If the condition of the dwelling requires a personal inspection and survey, the Mayor said the fee for this service would depend on time consumed and number of surveys in one locality, but would not exceed $10.

The Mayor announced that the arrangements for this Committee were made through the cooperation of the War Service Committee of the ASHVE, the New York Association of Consulting Engineers, and the New York chapter of the ASHVE, and he appointed Alfred J. Offner to serve as executive director for the Committee. The project is arranged to function on an actual cost basis, but, if any profits result, it is understood that these would be turned over to the Red Cross or the USO.

Within ten days of this announcement, Joseph T. Sharkey, vice-chairman of the City Council, charged Mayor LaGuardia at a Council meeting with "flagrant misuse of the tax-supported station WNYC" in telling in his Sunday broadcasts about the Mayor's Engineering Advisory Committee on Fuel.

Mr. Sharkey said he had received scores of complaints from oil burner technicians licensed by the city who said they would lose business to the Mayor's panel of experts. The city collected last year $10,440 from 522 licensed oil burner men.

"I don't like to see city officials steering business to personal friends, whether it takes the form of a Marriage License Bureau official to particular physicians for serological tests for marriage licenses or a Mayor doing commercial plugging over WNYC to get a monopoly on the business of furnace conversion for his friends," Mr. Sharkey continued.

"Most of these neighborhood heating men will be glad to advise home owners as to their fuel needs free of charge. Why pay the Mayor's experts $2 to $10 when the advice can be gotten for nothing."

Mayor LaGuardia, on leaving City Hall, said he was sure Mr. Sharkey would not have made his statement if he were not misinformed. The committee is being helpful to the taxpayers and the ASHVE is rendering a splendid service, he added.

OBI Issues Report

President C. E. Lewis of Oil Burner Institute early in September issued OBI's report entitled "A Study of Equitable Methods of Distribution of Fuel Oil to Domestic Users," which suggested methods of rationing based on principles believed to be fair. The methods were based on a survey of over 200 homes to which the recommended methods were applied. The report included tabulated results showing rationed amounts and possible savings.

According to President Lewis, "Most of the publicity in the past on the subject of fuel oil rationing has been theory rather than fact. The conclusions reached in this report are based on actual conditions as taken from the survey."

New England Situation

Acting to avert a "disastrous" fuel-oil shortage in New England, OPC on September 23 ordered an immediate increase in tank-car shipments to that area.

REVIEWS of TECHNICAL publications

COMBUSTION

"Combustion Efficiencies as Related to Performance of Domestic Heating Plants," by A. P. Kratz, S. Konzo, and D. W. Thomson. Published by the University of Illinois, Urbana, Illinois. Price, 40 cents.

A previous Engineering Experiment Station Bulletin showed that in any reasonably well-installed and carefully handled domestic heating plant, completely contained within the building, the overall house efficiency may be as high as 75 to 95%. This overall efficiency in the utilization of energy is largely dependent on the temperature and weight of flue gases, which also happen to be the main factors determining the combustion efficiency of the heating unit. Thus, the overall house efficiency and the combustion efficiency are directly related.

The purpose of the investigation outlined in this circular was to provide a simple means of evaluating the combustion efficiency from a simple check of flue gas temperature and CO_2 content. To provide for ready interpretation of these readings, the authors have included a complete series of curves from which total flue gas losses in percent can be read for various CO_2 contents and temperatures, also in which excess air, weights of air and dry flue gases, and pounds of moisture per pound of fuel burned are shown for various values of CO_2.

Extensive tabulation of products of combustion are also given for representative solid, liquid, and gaseous fuels for various quantities of excess air ranging from 0 to 300%.

Circular series No. 44, 30 pages, 6 x 9 in.

CONTRACTS

"The Negotiated Contract," by F. W. Lord. Published by Lord Electric Company, Inc., 10 Rockefeller Plaza, New York, N. Y.

This 21-page, 6 x 9 in. paper-covered booklet outlines a proposed method for awarding government construction contracts. The author presents it as a plan for negotiating contracts which would be fair to both Government and contractors, a scheme well-calculated to produce the maximum construction in the minimum time with the greatest possibility of saving to the public.

It is a ten-point program whose basic aim is to secure the speeding up in the awarding and the execution of Government construction contracts, at the same time insuring fair treatment to all the parties concerned.

DISTRICT HEATING

"Proceedings of the National District Heating Association for 1942." Published by the National District Heating Association, 827 N. Euclid Ave., Pittsburgh, Pa. Price, $5.

This 128-page, 6 by 9 in. cloth bound book gives the complete collection of papers, talks, and committee reports presented at the 33rd Annual Meeting held at Dayton, Ohio, June 11-12, 1942.

Included among the many reports were those on operating statistics, steam station engineering, commercial relations, rates and regulations, sales developments, and research.

A general summarization is given at the end of the book together with a subject index.

COAL COMBUSTION CHART

"Victory Begins in Your Home—Save Coal." Distributed free by Consumer Division, Office of Price Administration, Washington, D. C.

To serve as a constant reminder and a useful guide as to the proper methods of domestic firing, a 13 by 20 in. chart has been prepared by the Office of Bituminous Coal Consumers' Counsel. The chart gives detailed instructions and graphic illustrations as to the best methods of handling domestic furnaces. It is intended to be hung near the furnace for ready reference.

Two other bulletins which help to promote the same story are available and are entitled: "Buying and Burning Bituminous Coal," and "Save Coal at Home for Guns, Ships, Tanks, Planes, Victory," respectively.

HEAT TRANSFER

"Heat Transfer by Natural and Forced Convection," by A. P. Colburn. Published by the Engineering Experiment Station, Purdue University, Lafayette, Ind.

Research Series bulletin No. 84, 6 x 9 in., 63 pages, presents a series of lectures delivered at Purdue University a year ago. The author, who is professor of Chemical Engineering at the University of Delaware and a recognized author in the field of heat transmission, discussed the following subjects in detail: Introduction to Convection; Free Convection; Forced Convection, and Applications to the Design of Heat Exchangers.

A number of valuable curves and charts accompany the text.

HEAT ENGINEERING

"Principles of Heat Engineering," by N. P. Bailey. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price, $2.75.

Seldom is the broad field of heat engineering discussed so interestingly and explained so thoroughly as in this book. The author, who is connected with the General Electric Research Laboratories in Schenectady, is possessed of a style which makes for easy understanding; and, even though the subject is by nature a complex one, the text in most of its passages is readily followed. This is particularly true in the earlier chapters wherein a discussion of basic concepts and fundamental units lays a sound groundwork for the more advanced phases later on in the book.

The work is divided into 17 chapters dealing with such subjects as: characteristics of gases; thermal energy; combustion of fuels; heat transfer; compression of gases; internal combustion engines; steam engines and turbines; boilers, condensers, and powerplant cycles; and refrigeration.

Twenty-five pages at the end of the text are devoted to problems based on the various chapter contents, and the use of the book for reference purposes is facilitated by a subject index.

WELDING

"Code of Minimum Requirements for Instruction of Welding Operators." Published by the American Welding Society, 33 West 39th Street, New York, N. Y. Price 50 cents.

This 68-page, 6 x 9 inch paper-covered booklet comprising Part A of the revised Code and dealing with the arc welding of steel from 3/16 to ¾ inches thick, presents a revision of the proposed Code that was issued in 1941. The latter had been given wide circulation and reprinted by WPB for use in defining an "Accredited School."

The revised Code is expanded in several ways, particularly in respect to the supplementary material given in the appendices as suggestions to persons organizing courses in metal arc welding. The main sections of the Code consist of:

Equipment and facilities of the school, qualifications and duties of the instructor, instruction in welding practice, instruction in welding theory, and final tests.

The titles of the appendices are as follows:

Suggested accessory equipment for welding schools, recommended design of positioning equipment, recommended designs of testing apparatus and their application, recommended safety rules for student arc-welding operators, welding electrodes, suggested arc-welding exercises, suggested form of student progress chart, recommended form for record card, annotated selected bibliography of publications relating to arc-welding instruction.

COOLING TOWERS

"Design and Performance of Cooling Towers," by W. K. Hutchison and E. Spivey. Published by Institution of Chemical Engineers, 56 Victoria Street, London. S.W.I., England.

In a paper presented at a joint meeting of the Chemical Engineers and the Chemical Engineering Group in London, the authors outlined the procedures used in an investigation of the performance of cooling towers of standard design, including chimney draft and forced draft types. The studies were correlated on a basis of heat transfer in unit time and on unit cross-section of the cooling tower in relation to the inlet water temperature and to the degree of approach to the wet bulb temperature. Conclusions arrived at theoretically, and confirmed experimentally, were that performance would be improved by the use of smooth boards on edge in place of the triangular bars commonly used; and that with this type of packing a closer approach to the wet bulb temperature would be possible, with a considerable saving in size.

Consideration also was given to the methods of distribution of water over the packing with the view to avoiding water entrainment and to insure a maximum uniformity of distribution over wetted surfaces. A multitude trough type of distributor was found to best satisfy these requirements.

In the case of forced draft coolers, experiments showed that propeller fans with blades of true aerofoil section were the most efficient, giving a considerable saving in power.

Delivery air temperatures within 1 to 4F of the wet bulb temperature were shown to be practicable in towers of moderate size, with fan power consumptions not so large as to represent any considerable charge on the cost of the re-cooled water.

Pamphlet size 8½ x 11 in., 16 pages.

FUEL SAVINGS

"War on Fuel Waste — How to Do It." Published by American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York. Single copies free on receipt of self-addressed envelope.

A four-page folder devoted to war on fuel waste. Included are instructions as to the proper methods of hand-firing coal heating units, as well as recommendations regarding the conversion of oil burners to coal.

The folder features a ten-point program being urged by the Society in its fuel conservation campaign: Insulate Storm Windows and Doors; Insulate the Home; Add Window and Door Weatherstripping; Avoid Overheating; Maintain Lower Temperatures at Night and When Away From Home; Do not Heat Unused Rooms; Insulate Hot Water Heater; Improve Radiator Efficiency; Check Furnace Combustion Efficiency; and, Recondition Heating Plant.

INTERMITTENT HEATING

"Heat Requirements of Intermittently Heated Buildings," by E. G. Smith. Published by the Texas Engineering Experiment Station, A. & M. College of Texas, College Station, Texas.

In this 64 page, 8 x 9 in. bulletin No. 62, the author, who is Associate Professor of Physics at the A. & M. College of Texas, deals with a problem frequently confronting heating and ventilating engineers, namely: the determination of the required size of heating plant for churches, auditoriums, and similar buildings. Due to the large heat storage capacity of the masses of cold materials which must be warmed-up before such structures can be made comfortable, a plant which would be entirely satisfactory for a continuously heated building is frequently much too small for the same building when heated intermittently.

This bulletin provides a method which will permit a rapid and accurate calculation of the heat requirement. It embraces a method by which heat absorbances rather than the conductivity of materials is utilized. Thus, the absorbance of a wall is defined as a number which when multiplied by the product of the desired increase in the indoor air temperature and the surface area of the wall results in the number of Btu's per hour which must be supplied to the wall in order to secure the desired increase of indoor air temperature in a specified time. To illustrate the disparity in heat requirements as calculated by the absorbance method and the conventional conductivity method, the author uses one of the college buildings as an example. The absorbance method of calculation showed a total required input of 4,280,000 Btu's per hr as against 780,000 by the steady state conductance method, or a ratio of about 5½ to 1.

Recent experiences of many heating and ventilating engineers similarly indicated that rapid intermittent heating of heavily-constructed concrete and steel buildings require a heat input of five or six times the normal steady state transmission loss which occurs when the building is up to temperature.

Included in the bulletin is a table of absorbances for approximately 200 miscellaneous objects and materials normally met with in figuring building heating loads.

TRANSFER OF ENERGY

"Transfer Processes in Annuli," by J. H. Wiegand and E. M. Baker. Published by the American Institute of Chemical Engineers, 50 E. 41st St., New York, N. Y.

A 6 x 9 in., 24 page reprint from the Transactions of the American Institute of Chemical Engineers, Vol. 38, No. 3, June 25, 1942, dealing with the rate of transfer of energy as friction and heat in annuli. Deductions for both laminar flow and turbulent flow are given.

AIR CONDITIONING

"Air Conditioning for Houses in California," by H. S. Gordon and R. L. Perry. Published by the University of California Agricultural Experiment Station, Berkeley, California.

Although all-year-round air conditioning and the use of mechanical equipment for cooling houses in summer have become rather commonplace, many house owners nevertheless desire to know more about results obtainable by various methods of air conditioning and about the approximate cost of equipment. The purpose of the authors, both of whom are members of the University staff, is to furnish such information in this circular.

A condensed table furnishes performance and cost data on refrigeration air conditioning equipment and on direct and indirect evaporative coolers, as well as for the attic fans for ventilation and night cooling. A glossary of technical air conditioning terms is included at the back of the bulletin.

Circular No. 351, 6 x 9 in., 48 pages, paper covered.

HEAT TRANSFER

"Heat Transfer By Convection in Annular Spaces," by C. C. Monrad and J. F. Pelton. Published by the American Institute of Chemical Engineers, 50 East 41st Street, New York, N. Y.

A presentation of the results of an investigation covering heat transfer for the inner tube of annuli with three ratios of outer to inner tube diameters, namely 1.65, 2.45 and 17. Water and air over a temperature range of 80F to 180F, and with Reynold's numbers varying from 12,000 to 220,000, were used.

This paper is a reprint from the Transactions of American Institute of Chemical Engineers, Vol. 38, No. 3, June 25, 1942. Paper covered, 6 x 9 in., 18 pages.

HEATING STANDARDS

"Gas Floor Furnaces — Gravity Circulating Type — Commercial Standard CS99-42." Available from the Superintendent of Documents, Washington, D. C. Price 5 cents.

Publication of this fourteen-page, 6 x 9 inch, paper-covered pamphlet is announced by the National Bureau of Standards of the U. S. Department of Commerce. The purpose of the standard, which was adopted December 4, 1941, at a general conference of manufacturers, distributors, and users of gas floor furnaces of this type is to establish (1) minimum specifications, (2) to avoid delays and misunderstandings, and (3) to provide a uniform basis for guaranteeing compliance through the use of labels or certification.

NEWS OF THE MONTH

Oil Burner Men in New England Form New Institute; Will be Part of Proposed National Group

BOSTON—A new regional oil heating institute for New England has been formed, and incorporated under the association incorporation laws of Massachusetts as the Oil Heating Institute of New England. It will function as the connecting link between the various dealers of oil heating equipment and fuel in New England with the former Oil Burner Institute, which is expected to change its name to the Oil Heating Institute of America at its meeting October 13. New England headquarters will be at 739 Beacon Street, Boston.

The Massachusetts Oil Heating Association will retain its identity and organization as a separate entity, holding its regular monthly meetings and acting on behalf of members of the oil heating industry in Massachusetts matters. Other local organizations will also retain their separate identity, but they will be affiliated with the New England organization, which will be a chapter of the national institute.

Thus, with other chapters to be formed for various sections of the country, the oil heating industry will have a national body in a position to act, with the backing of some 2,000 or more affiliated membership, nationally when matters or problems come up affecting the industry as a whole. The Oil Heating Institute of New England will have a permanent executive secretary and a staff sufficiently large to carry on all necessary activities, acting as a clearing house for necessary information to enable members to operate under the many rules and regulations coming from the war effort.

The organization committee consists of J. Henry Brody, chairman, Fred N. Beckwith, secretary, Don Edwards, Frank P. Scully and Charles B. Soper. It is emphasized by the committee that there will be no competition between the new association and local organizations in the same field. They will deal with their local problems while the regional organization will act for the interests of the industry in all New England, and co-operate with the national body in solution of national problems. There will be five divisions of membership —manufacturers, open to all corporations, firms and individuals manufacturing and selling all classes of oil burners and oil burning appliances; accessory membership, open similarly to those engaged in some allied or affiliated industry or business; dealer group membership, open to incorporated dealer groups whose members are engaged in the selling, installing and servicing of oil burners and oil burner appliances, and/or the selling of fuel oils; oil marketing membership, open to all corporations, firms or individuals engaged in the marketing of fuel oil, nationally or regionally through distributors and dealers in local markets; honorary membership, to be voted by the Board of Directors to individuals in recognition of services rendered for the progress and development of oil heating or for other outstanding accomplishments.

House Building At New Peak

MINNEAPOLIS—Houses built in 310 leading American cities in 1941 reached the highest value and volume in twelve years, according to E. E. Crabb, president of Investors Syndicate, in reporting preliminary results of the company's seventh annual national housing survey.

"Value and volume of new houses erected last year," continued Mr. Crabb, "were more than eleven times the 1934 totals, the low for the last twelve years.

"Dwelling units in these 310 U. S. cities, as of January 1, 1942, approximated 14,869,245. Of this total, 9.1%, or 1,356,787 dwelling units were 11 years or less old, having been built from January 1, 1931, to the first day of this year.

"A record-breaking number of marriages, wide shifts in population resulting from the defense program—all of the houses reported on this survey were started well before Pearl Harbor, and most of them were finished before that day—and rising national income, accelerated home building last year. Advancing rents in some regions, declining vacancies in many sections, and the ease of financing, coupled with the obsolescence of existing house units, also sped residential construction.

"The average cost per person for new houses was 2.7% higher than in 1940.

"Dwelling units put up in these 310 cities last year were 7,179 more than all of the new homes constructed in these same cities from 1931 to 1935, inclusive."

The 310 cities included in the survey, located in 41 states and the District of Columbia, had a population of 50,035,520, or 38% of the nation's population.

WPB Industry Groups Formed

WASHINGTON—Formation of two industry advisory committees were announced September 5 by the War Production Board.

Members of the Heating Contractors Industry committee, one of the two, are: Henry S. Blank, Dayton, Ohio; Louis Breer, president, Lohman Brothers Co., Los Angeles, Calif.; Paul Greiner, Paul Greiner Co., Wheeling, W. Va.; Edmund P. Ingram, owner, Edmund P. Ingram Co., Jersey City, N. J.; K. A. Stephenson, president, Stephenson Company, Inc., Atlanta, Ga.; E. W. Verity, president, Almirall & Co., New York, N. Y.; Rupert J. Weber, owner, Jacob G. Weber Co., Chicago, Ill., and John Zink, president, The Heat & Power Corp., Baltimore, Md.

The other committee is that of the Plumbing and Heating Manufacturers Industry, members of which are: William M. Byrd, Jr., vice-president, Alabama Pipe Co., Chicago, Ill.; J. H. Collier, president, Crane Co., Chicago, Ill.; N. J. Higginbotham, president, W. A. Case & Sons Mfg. Co., Buffalo, N. Y.; Herbert V. Kohler, president, Kohler Co., Kohler, Wis.; W. Keith McAfee, president, Universal Sanitary Mfg. Co., New Castle, Pa.; L. R. Mendelson, president, Hotstream Heater Co., Cleveland, Ohio; Harold P. Mueller, president, L. J. Mueller Furnace Co., Milwaukee, Wis.; Henry M. Reed, president, American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.; S. J. Reeves, vice-president, Reeves Steel & Mfg. Co., Dover, Ohio; E. C. Sammons, vice-president, Iron Fireman Mfg. Co., Portland, Ore.; Harold W. Sweatt, president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., and Reuben N. Trane, president, The Trane Co., La Crosse, Wis.

H. V. Coes Elected by ASME

NEW YORK—Harold V. Coes, vice-president of Ford, Bacon & Davis, Inc., New York has been elected president of The American Society of Mechanical Engineers during 1943. Vice-presidents, elected at the same time to serve two-year terms on the council of the ASME were Joseph W. Eshelman, president, Eshelman & Potter, Birmingham; Thomas E. Purcell, general superintendent of power stations of the Duquesne Light Company, Pittsburgh; Guy T. Shoemaker, vice-president, Kansas City Light & Power Company; Walter J. Wohlenberg, professor of mechanical engineering, Yale University.

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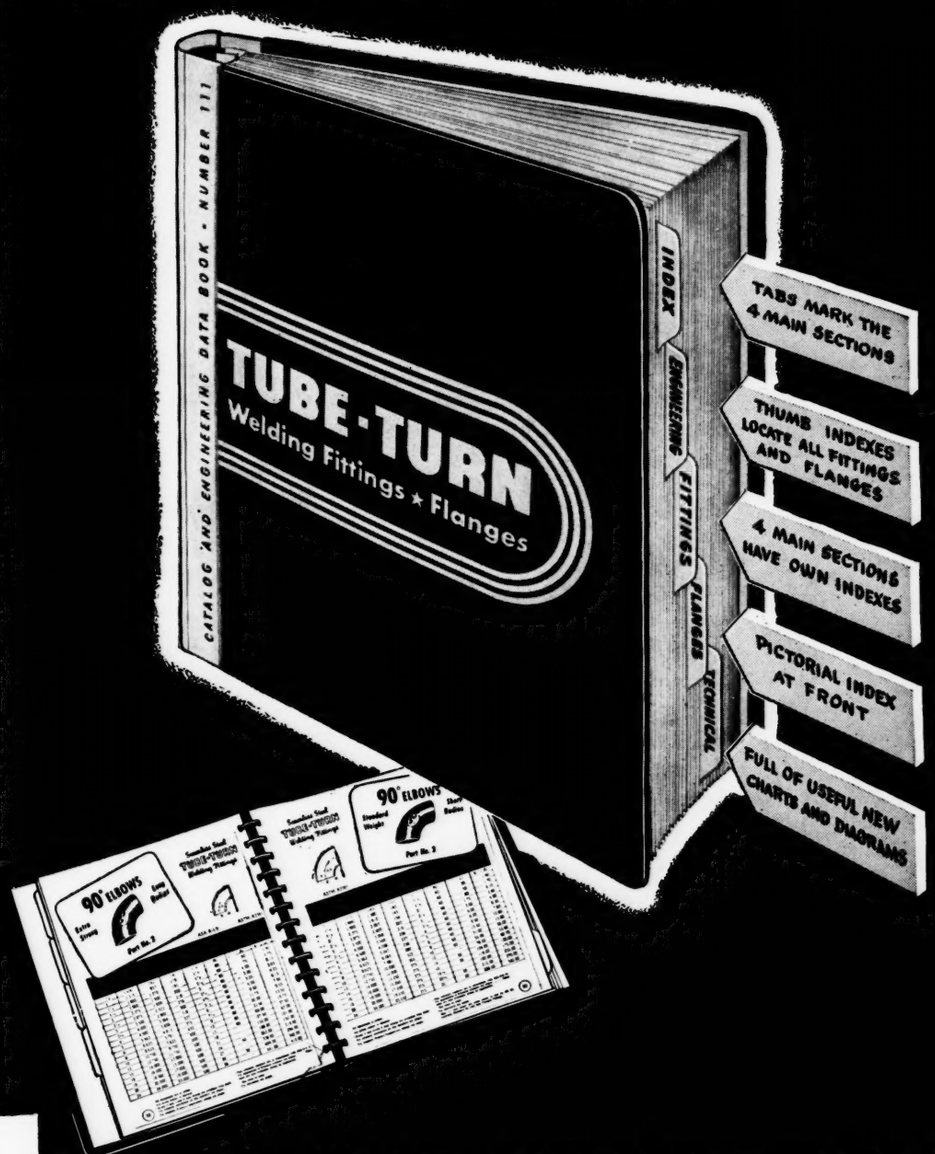

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Bureau of Census Issues Fuel Data on Single Houses; Montana Leads in Gas Heat in States Reporting

WASHINGTON—Figures for 38 states and the District of Columbia indicate that, of the states covered, the District of Columbia leads in per cent of dwelling units heated by *central* heating plants burning oil (20.7 per cent) followed by Connecticut (18.3 per cent) and Maryland (17.1 per cent). The percentage figure is that of the state's total. The data are from the sixteenth Census of the United States as reported by the Bureau of Census.

It should be noted that these figures are on the basis of *dwelling units* and not *structures*. That is, an apartment house with 12 apartments is one structure but 12 dwelling units.

Montana leads in central gas heated dwelling units (13.9 per cent) followed by Wyoming (11.4 per cent), Kansas (11.3 per cent) and District of Columbia (10.3 per cent).

Figures are not yet available for California, Illinois, Michigan, Minnesota, Missouri, Nebraska, Ohio, Pennsylvania, Texas, and Virginia.

Figures for the states so far reported, both centrally and individually heated, are shown in the accompanying table.

A.C. for Cabooses?

ST. THOMAS, ONT.—It is reported among union members at this divisional point for the Michigan Central, Wabash and Pere Marquette railways, that the air-conditioning of freight train cabooses will be demanded after the war. The men feel that the crews are entitled to this necessary comfort owing to the fact that in the summer the vans become suffocatingly hot.

HEATING FUEL USED IN CERTAIN STATES, 1940, IN PER CENT OF DWELLING UNITS

		Central Heating Per Cent of State Total Dwelling Units					Without Central Heating Per Cent of State Total Dwelling Units				
	Dwelling Units Reporting Heating Equipment	Coal and Coke	Wood	Gas	Fuel Oil	Other	Coal and Coke	Wood	Gas	Fuel Oil	Other
Alabama	649,082	4.5	0.2	0.4	0.1	0.1	35.1	56.0	2.7	0.3	0.6
Arizona	125,807	0.9	0.3	4.9	1.6	0.4	4.1	43.3	15.6	15.0	14.0
Arkansas	482,656	0.5	0.2	0.9	0.1	—	5.9	77.4	13.7	0.6	0.7
Colorado	309,953	31.3	0.1	5.9	0.7	0.6	50.2	6.0	1.6	1.6	2.2
Connecticut	440,570	37.0	1.6	0.7	18.3	1.1	11.5	5.3	0.4	18.6	5.6
Delaware	69,695	36.4	0.3	0.6	15.8	0.4	20.0	18.6	0.1	6.3	1.5
Dist. of Columbia	170,888	55.8	—	10.3	20.7	0.9	9.1	0.5	0.4	0.8	1.5
Florida	498,279	0.5	0.6	0.4	1.4	0.4	3.0	54.3	2.7	4.6	32.5
Georgia	728,559	5.2	0.2	1.1	0.2	0.1	33.8	54.8	3.1	0.8	0.6
Idaho	138,412	15.1	2.3	—	0.6	0.9	38.3	36.9	0.1	2.9	3.0
Indiana	950,097	42.0	0.5	0.6	1.1	0.7	45.1	8.5	0.3	0.9	0.4
Iowa	693,183	40.6	2.7	2.1	3.7	0.6	30.4	13.9	0.4	5.0	0.6
Kansas	502,858	12.3	1.5	11.3	0.7	0.2	28.3	26.1	16.2	2.5	0.8
Kentucky	686,516	14.5	0.1	1.2	0.1	0.1	57.7	21.1	4.7	0.1	0.3
Louisiana	577,962	0.4	0.2	1.1	0.5	0.1	6.9	55.3	28.0	1.1	6.3
Maine	215,722	22.1	9.2	0.1	7.6	0.9	6.7	43.4	0.1	7.5	2.4
Maryland	456,761	37.9	0.3	2.1	17.1	0.7	19.9	14.7	0.4	2.8	4.2
Massachusetts	1,099,662	45.7	1.2	0.9	16.2	1.3	10.0	3.3	0.3	16.5	4.5
Mississippi	515,412	0.4	0.5	0.8	0.1	—	10.3	78.5	8.6	0.2	0.6
Montana	156,551	11.9	1.8	13.9	0.7	0.4	33.6	22.2	11.5	2.8	1.1
Nevada	32,101	6.3	0.4	—	10.0	1.0	27.4	28.1	0.6	19.2	6.9
New Hampshire	131,086	25.7	6.6	0.3	12.0	1.0	8.8	29.3	0.1	12.7	3.6
New Jersey	1,082,761	54.1	0.4	1.2	15.2	1.0	16.2	2.2	0.3	5.8	3.7
New Mexico	124,354	3.4	0.1	6.6	0.2	0.2	20.2	46.0	14.2	2.3	6.9
New York	3,579,550	58.8	0.6	1.9	12.6	2.4	13.3	3.5	1.0	3.7	2.1
North Carolina	770,568	6.8	0.2	—	0.6	0.1	35.6	53.8	0.1	2.1	0.8
North Dakota	149,932	32.0	0.8	2.3	1.9	1.2	52.5	6.0	0.4	2.3	0.5
Oklahoma	586,255	0.5	0.2	5.1	0.1	0.1	12.1	39.6	39.8	0.7	1.9
Oregon	330,479	2.4	16.9	1.8	9.6	4.0	1.8	55.6	0.6	5.1	2.0
Rhode Island	186,303	32.6	0.7	0.8	14.9	0.7	15.5	3.5	0.4	22.4	8.5
South Carolina	425,187	2.7	0.1	—	0.4	0.1	33.6	58.6	0.2	2.3	2.1
South Dakota	162,571	25.2	1.8	3.2	2.3	0.6	40.0	18.1	2.1	6.0	0.8
Tennessee	703,927	11.3	0.1	1.6	0.1	0.1	44.8	39.5	1.6	0.3	0.5
Utah	137,803	25.1	0.1	7.3	0.2	0.4	57.3	6.1	2.0	0.4	1.0
Vermont	91,476	23.3	9.1	0.1	7.6	0.9	12.5	38.4	0.1	6.6	1.4
Washington	526,433	12.7	7.1	0.6	12.8	2.4	7.2	45.0	0.3	9.1	3.0
West Virginia	432,033	11.7	0.1	3.1	—	0.1	47.8	10.1	26.6	—	0.3
Wisconsin	819,781	46.1	5.4	0.4	4.2	0.7	16.3	21.3	0.1	5.1	0.4
Wyoming	68,234	13.7	0.1	11.4	0.6	0.3	44.5	10.8	14.5	2.3	1.6

Source: Sixteenth Census of the United States, Housing Series.

Filter Maintenance Is Stressed as Fuel Conservation Measure

DETROIT — As part of the nationwide Fuel Conservation Program, Research Products Corp., Madison, Wis., and Wm. G. Boales & Associates of Detroit sponsored on Aug. 27 a meeting of dealers, jobbers and others interested in heating and air conditioning.

Speakers at the meeting stressed the necessity of saving fuel. They showed that lower temperatures, insulation, storm windows, better firing were essential and pointed out that more frequent air filter replacement was highly important to conservation of fuel because dirt loaded filters cause inefficient heating. Considerable interest was shown by those present and all better realized the important part filters play in fuel conservation and that too little attention has been given to them in the past.

Among those who addressed the 120 guests were Harvey M. Merker, president of the Engineering Society of Detroit; Kemper Slidell, president of Research Products Corp.; Wm. G. Boales, Michigan representative of Research Products Corp.; M. B. Shea, president of the Michigan chapter of the ASHVE; Pat Norris, Research Products Corp.; Dewey Cain, vice-president, Detroit Association of Warm Air Heating Contractors; and H. O. Nelson, president, Plumbing & Heating Industries Bureau. After the program, a buffet supper was served.

Canada to Ban Oil Heat in '43

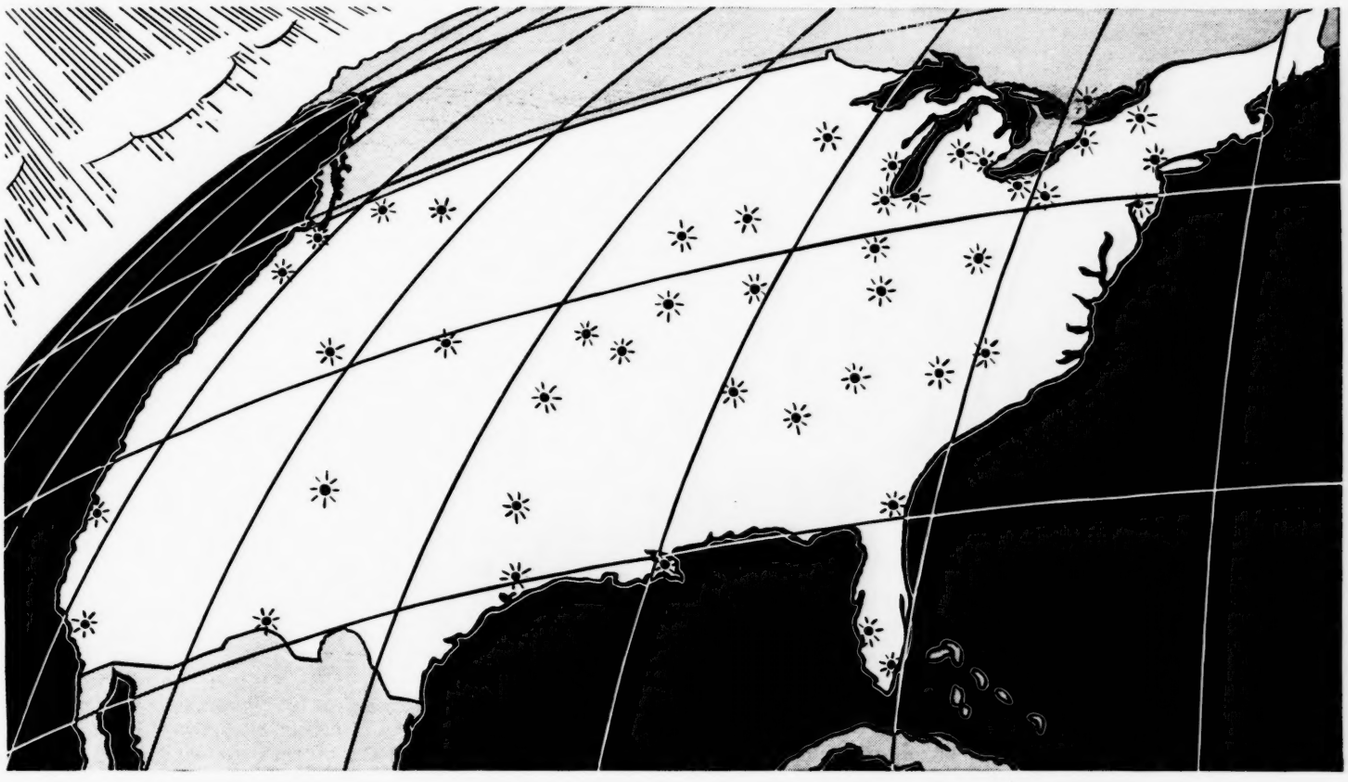
OTTAWA, ONT. — Supply Minister C. D. Howe, has announced that all domestic oil heating would be banned next winter in Canada. While the government did not intend to interfere with those who heat buildings and homes with oil, Oil Controller George R. Cottrelle explained that about 22% of the total fuel oil consumed in Canada was used by home oil burners.

Contractors Pool for War Work

NEW YORK—A delegation of members of the American Contractors War Advisory Committee, headed by Philip Wolf, chairman, visited Washington September 18 to complete arrangements for medium sized Government contracts for recently organized pools of New York and New Jersey contractors in various branches of the building industry.

This Committee was recently formed to help small contractors to secure war orders by combining their resources in incorporated emergency bidding pools. Each pool is to be composed of four or more concerns.

Strategic Heating Points



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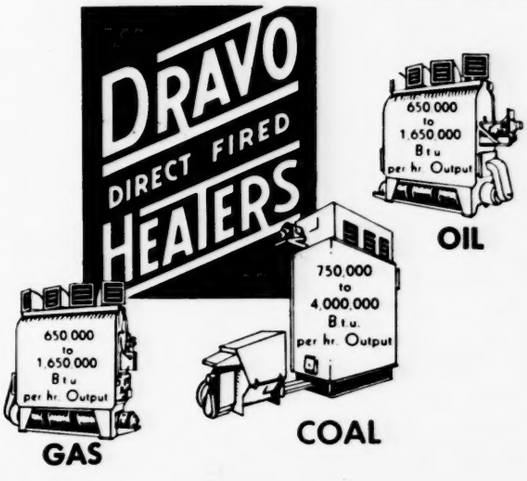

News of the Month

Plans Study of Waste Manpower

PITTSBURGH — How-measures for cutting our manpower wastage in the face of a threatened labor shortage will be detailed at the seventh annual meeting of the Industrial Hygiene Foundation which is scheduled for Mellon Institute, Pittsburgh, November 10-11. The meeting of Foundation members has for its theme "Health Arms the War Workers."

Because this subject of wasted manpower is still too much in the talk stage, the Foundation urges these practical measures for member companies and other industrial concerns in war work: (1) Immediate audits and analysis of absences to determine the amount of time lost from illness and non-industrial injuries, the cause and location; (2) Immediate industrial hygiene surveys to locate and eliminate hazards, such as chemical fumes, dusts, etc., endangering the health of workers, and (3) Modern medical departments within industry, ably staffed and armed with authority to direct employee health protection in all phases.

This plan of action, which promises actual progress in saving work days, will be amplified at the Foundation's annual meeting. Intensifying the demands for an industrial health offense now are these factors: (1) Increased use of chemicals, some of them unfamiliar substances with little-known toxic effect; (2) Longer work periods and consequent longer exposures to toxic materials, perhaps sufficient to tip the balance between health and sickness; (3) Increased employment of women, youths and older men who may lack the resistance of normal workers, and "safe limits" for known toxic substances are based on normal workers; and (4) Increased production tends to increase health hazards all along the line and may lead to many serious results.

Sees Post-War House Demand

WASHINGTON—A vast potential demand for new homes in the post-war era which "will challenge our industrial, financial, and political ingenuity," is forecast by a pamphlet, "The Role of the Housebuilding Industry," released here September 12 by the National Resources Planning Board as the fourth in a series of studies on post-war planning.

Prepared by Miles L. Colean, formerly assistant federal housing commissioner and now director of the Housing Survey of the Twentieth Century Fund, the pamphlet predicts a decade of a million new homes per year.

Coal Use Rises in Bay State

BOSTON—The relative importance of fuels used for house heating in Massachusetts, as shown by the annual survey made by the Division on the Necessaries of Life of the Commonwealth Department of Labor and Industries shows a decided increase in the consumption of anthracite and bituminous coal, while coke and oil consumption decreased.

Comparative figures for the 1940-1941 and 1941-1942 coal years are as follows:

Fuel	1940-'41	1941-'42
Anthracite, 1000 tons.	2,594	2,828
Coke, 1000 tons	900	820
Soft Coal, 1000 tons ..	815	1,023
Briquets, 1000 tons ...	39	37
Other Mfd. Fuels, 1000 tons	25	41
Oil, million gallons...	895	837
Gas, million cu. ft.....	4,154	4,448

Deliveries of domestic-sized anthracite showed an increase of 237,000 net tons and bituminous coal an increase of 208,000 net tons over the previous year, while coke consumption decreased 79,600 net tons. A decrease of 57,800,000 gallons was noted in the consumption of fuel oils.

All Fuel Rationing Reorganized

WASHINGTON — All fuel rationing activities were reorganized as a new division of the Office of Price Administration, Leon Henderson, Administrator, announced September 7. In addition to administering the gasoline rationing program, this new Fuel Rationing Division has charge of fuel oil rationing activities.

The Director of the new Division is Joel Dean, who was chief of the former Fuel Rationing Branch. Mr. Dean, a member of the faculty of the University of Chicago, and an industrial engineer, came to OPA in 1941 as price executive in charge of the Machinery Branch. He has been in charge of the gasoline rationing program since its inception.

The Assistant Director of the new Division is Wallace S. Sayre, who was chief of the Operations Section of the Fuel Rationing Branch. He was formerly one of New York City's three Civil Service Commissioners.

The new Fuel Rationing Division will have three operating branches: Gasoline Rationing Branch, Fuel Oil Rationing Branch, and Industry Relations Branch. John G. Neukom, the new Chief of the Fuel Oil Rationing Branch, is a member of McKinsey, Kearney and Company, Chicago, industrial engineers.

Exams for L. A. Contractors

LOS ANGELES — Compulsory examinations to determine the qualifications of local refrigeration contractors, journeymen installers and helpers will be required under the provisions being written into the revised city refrigeration code now in process of revision and amendment under the direction of A. B. Wicks, head of the Heating, Ventilating and Refrigeration Division of the Municipal Building and Safety Department.

The new code will establish examination and registration fees and will require contractors and installers to obtain a certificate of operation along a plan basically similar to the provisions of the recently enacted ordinance requiring examinations and certificates for warm air heating contractors. The new code and its examination provisions will affect some 200 refrigeration contractors and 400 journeymen. Operating engineers will not be affected.

P&HIB Will Meet October 22

CHICAGO — Fostering of peacetime markets by continued improvement in public relations during wartime will be discussed at the annual meeting of the Plumbing and Heating Industries Bureau to be held in the Palmer House October 22, according to H. O. Nelson, Detroit, president of the Bureau. The annual meeting of the Bureau coincides with the fall convention of The Central Supply Association scheduled for October 22-23.

In a statement on the meeting, Mr. Nelson called attention to the function of publicity in wartime:

"The plumbing and heating industries have done a splendid job in providing equipment, and installing it, promptly and efficiently, in army camps, naval training stations, ships, and other places where it is vitally needed in the war effort," Mr. Nelson said. "All branches of the industries — manufacturers, wholesalers, and contractors—deserve credit for this achievement.

"Representatives of the war department as well as the navy department have commented on the fine service of the industries."

Alfred E. Seelig

NEW YORK—Alfred E. Seelig, president and general manager of the L. J. Wing Mfg. Company, died September 13 after a long illness. He was 54.

Mr. Seelig was associated with the L. J. Wing Mfg. Co. for 26 years and was responsible for much of the development work of that company's turbine and blower division.

IGLOO
WIGWAM

With the armed forces—In Iceland they call these huts "igloos," in Panama they're "wigwams." At widely-separated points, in the Americas and overseas, structures of this type are housing men of the U. S. Army. This is but one of the many ways in which Bethlehem Galvanized Sheets are serving the armed forces.

SHEETS
in the war effort

On the home front—Bethlehem Galvanized Steel Sheets are helping in the war effort along the home front, too. In war housing the nation over, warm-air ducts, ventilators and stacks of Bethlehem Galvanized Sheets are on the job. In Army camps and training centers, in Navy establishments and Air Corps training schools, Bethlehem Galvanized Sheets are doing routine but important work.

On the production line—In war production plants Bethlehem Galvanized Sheets are serving as roofing and siding, in air ducts and many other applications. Bethlehem Hot- and Cold-Rolled Sheets in large tonnages are going into war products ranging from powder cans, ammunition racks and bomb fins to anti-submarine net buoys, hatch coamings and extensive uses on destroyers and battleships.

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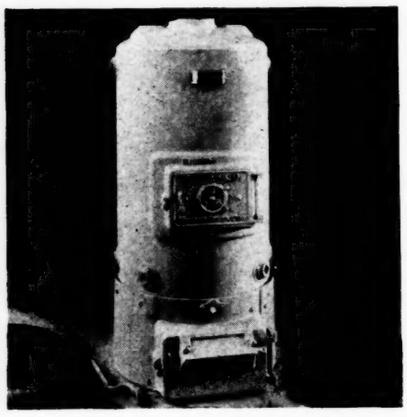
BETHLEHEM STEEL COMPANY

NEW EQUIPMENT

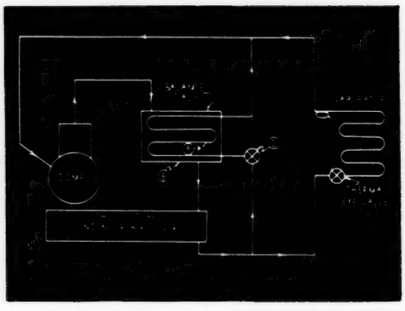


Welded Water Heater

NAME—Kewanee All-Weld Tabasco.
PURPOSE — For domestic or commercial water heating.
FEATURES—This all-welded heater succeeds the company's previous line of riveted heaters. Shell is formed from full gauge steel plate with heads accurately formed and fitted and welded all around. A high proportion of primary heating surface gives a high rate of heat absorption. Mud ring is of steel. Large fire door permits use of good size shovel when hand-firing. Five washout plugs provide access for cleaning inside surfaces of top heads as well as the bottom ring. The shell assembly rests upon a newly-designed base equipped with heavy rocking grate bars and an ashpit door with either a sliding air adjustment plate for hand-firing or a draft door and flap for automatic firing. Safe working pressure up to 100 lb, hydrostatically tested at 200 lb per sq in.
SIZES AND CAPACITIES — Available in 10 sizes, from 130 to 700 gal per hr with 50F rise.
LITERATURE AVAILABLE — Catalog TW-95b.
MADE BY — *Kewanee Boiler Corporation, Kewanee, Illinois.*

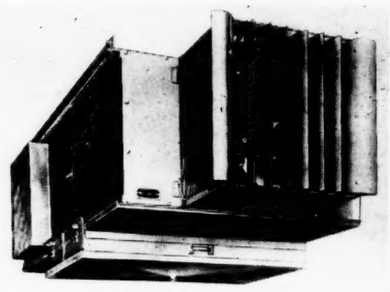
Refrigeration Balancer

NAME—Kramer Balance Loader System.
PURPOSE — To provide full-range automatic variation in the capacity of refrigeration systems to fit the requirements.
FEATURES — The balance loader consists essentially of a heat exchanger which is composed of a direct expansion coil within a cylindrical shell. The unit is so installed in the conventional refrigerating system that hot gas from the compressor passes through the shell of the loader and over the direct expansion coil on its way to the main condenser. In so doing there is an exchange of heat between the hot gas and the cold refrigerant in the balance loader coil. Refrigerant taken from a point between the condenser and the evaporator is supplied to this coil through a constant pressure expansion valve and the outlet of the coil is connected to the suction line of the compressor. As the heat load at the evaporator is reduced, the resulting reduction in suction pressure will open the constant pressure valve at the balance loader which will automatically maintain the suction pressure at constant predetermined level. Five significant results are claimed for this system. (1) Constant back pressure, (2) elimination of lubricating and seal troubles, due to the unusually low crankcase pressure, (3) preventing icing of air conditioning coils, (4) ability to partially flood evaporator, and (5) close control.
SIZES—Made in eleven sizes, from 12,000 to 360,000 Btu per hr.
LITERATURE AVAILABLE — Catalog B-L 342.
MADE BY — *Kramer Trenton Company, Trenton, N. J.*



Fat From Exhaust Ducts

NAME — Grease reclaiming service.
PURPOSE—For fire-proofing and removing grease from exhaust ducts.
FEATURES—The service consists in the removal by chemical process of fats and grease which collect in ductwork and exhaust vents. The fats thus reclaimed are converted into glycerine for war use. An estimated 25 to 300 lb of grease is said to be reclaimable from the average restaurant. This service seals all leaks, prevents grease from dripping back into food and fire-proofs and grease-proofs the vent pipes, thus also decreasing air friction and improving efficiency. Further information obtainable from the Chemical Service Corporation.
MADE BY—*Chemical Service Corporation, 6335 Hammel Avenue, Cincinnati, Ohio.*

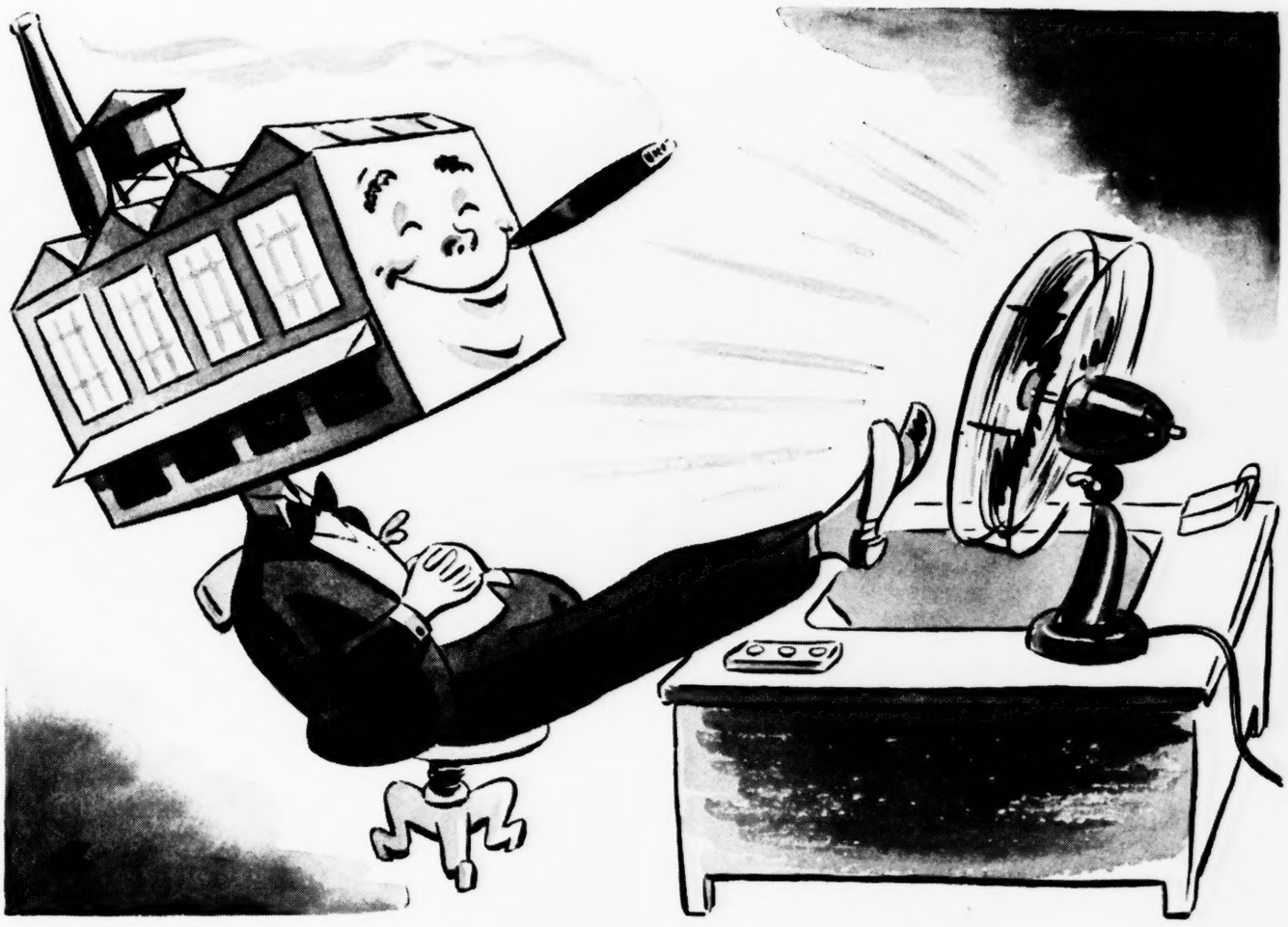


Industrial Humidifier

NAME—Carrier industrial humidifier.
PURPOSE — To provide automatic humidification, cooling by evaporation, fresh air ventilation, and tempering, cleaning, and uniform circulation in industrial buildings.
FEATURES—Consists of a horizontal cooling, humidifying, and heating unit with propeller type fan and direct connected motor. The unit is of the overhead-suspension type, requiring no floor space. Humidification is accomplished by humidifying packs fed through a flooding pan with weirs. The drip pan on ball-bearing rollers moves on a track permitting complete access to the interior of the unit and humidifying packs from the bottom. The air outlet is hinged and can be swung aside providing direct access to the fan and fan motor. Has outdoor air intake connection fitted with dampers, automatically controlled, making the unit suitable for factory ventilation during blackouts.
SIZES—Overall dimensions: 97 11/16 in long, 57½ in. wide and 39 in. high, with ½ or 1½ hp fan motor.
MADE BY — *Carrier Corporation, South Geddes Street, Syracuse, N. Y.*

War Gas Extinguisher

NAME—Adams fire extinguisher.
PURPOSE—For use as a fire extinguisher and a decontaminator for the three major war gases.
FEATURES—A new material said to be non-injurious and one that will last indefinitely in storage. One cubic inch will produce over 1000 cubic inches of fire-smothering gases upon contact with fire, according to the manufacturer. Said to be very effective in combating gasoline, oil, paint, grease, and most types of industrial and marine fires and when used against chlorine, phosgene, and tear gas.
SIZES—Available in 1 lb and 3 lb tubes.
MADE BY—*O. H. Adams Company, 2018 E. Thomas Avenue, Milwaukee, Wis.*



Industrial plants thrive on fresh, clean air

EFFICIENCY ENGINEERS have proved that more work and better work is produced in factories and offices where the air is clean and fresh.

Now, Fiberglas* Dust-Stop* Air Filters enable practically any organization to enjoy clean-air benefits.

For, these filters can be quickly and economically installed in the majority of heating, ventilating, or air conditioning systems.

Dust-Stops are now helping to bring important results to many of America's War Production Plants. They are eliminating so-called "nuisance" dusts . . . contributing to better working conditions for precision manufacture . . . resulting in fewer rejects . . . a definite saving of money, minutes, and material.

Apply These Dust-Stop Advantages to Your Plant

Performance: Dust-Stop capacity is 2 CFM per sq. inch of area at 300 FPM. Average resistance, new, in inches of water gauge: .062 for the 1-inch, .13 for the 2-inch.

Economy: These filters cost only 1c per CFM to install, and less than 1/10th of 1c per CFM to replace. Further savings are obtained by reusing filters after gently tapping out or vacuum cleaning.

Easy to Change: It's no job to change Dust-Stop Air Filters. Anyone can replace old filters with new Dust-Stops in a jiffy.

Fire-Safety: Dust-Stop Filtering material is glass . . . the individual fibers CAN'T burn. The adhesive is noncombustible. Dust-Stop* Filters are tested and approved by Underwriters Laboratories, Inc., as meeting all fire hazard requirements.

Availability: Made from materials which are abundant and easily available right here in this country.

Dust-Stop Filters are available in Standard filter sizes. They come in two thicknesses: No. 1 (1 inch thick), No. 2 (2 inches thick). Ask your leading air-conditioning manufacturer, jobber, or dealer about them. If they can't supply samples, prices, and complete information, write to us today.

FIBERGLAS*

DUSTOP*

AIR FILTERS

*T. M. Reg. U. S. Pat. Off.

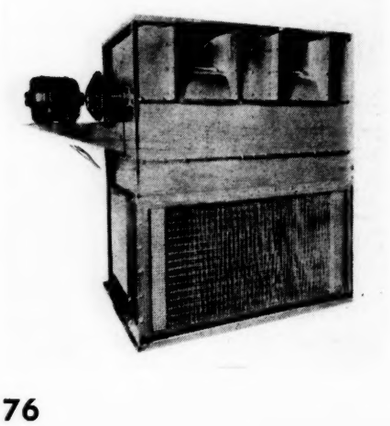
Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, order from Fiberglas Canada, Limited, Oshawa, Ontario.

Motor-Operated Valves

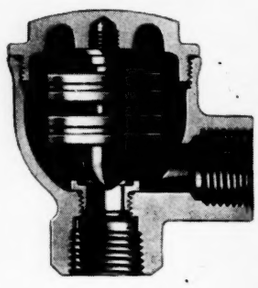
NAME — Direct current motor-operated valves.
PURPOSE — For on-off control of steam, water, or gas and, in certain cases, for oil or brine.
FEATURES — Has new direct current operator mounted on one of the company's three standard types of valve bodies. Operator is of heavy duty type designed for marine and industrial applications and powered by ballbearing Eicor series-wound unidirectional motor. Has silver contacts, beryllium copper limit switches, precision-hobbed heat-treated gears, hardened and polished steel eccentric cam for operation of valve plunger, and all motor parts corrosion-proofed and enclosed in a tight fitting metal cover. For three wire control in 24, 115, or 230 volts d.c. Operator detachable as a unit and may be installed in any position, but preferably upright.
SIZES — From ½ to 2 in. I.P.S., 35-second timing, pressures 70 to 150 lb, depending upon type.
LITERATURE AVAILABLE—Bulletin F-1786.
MADE BY — *Barber-Colman Company, Rockford, Ill.*

Industrial Refrigeration Unit

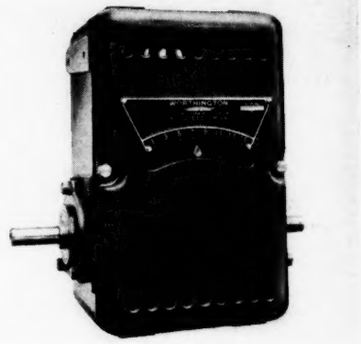
NAME — Type AVL industrial refrigeration unit.
PURPOSE — For process refrigeration and for industrial space cooling.
FEATURES—Consists of a vertical conditioning unit, shipped in two separate assemblies to facilitate handling and passage through a 36 in. door. The fan section at the top has two centrifugal blower wheels mounted on a common shaft and is so designed that fan discharge can be either horizontal to the front or rear, or vertical upward. Fan openings are provided with flanges to permit easy attachment of ductwork or cowls. Coil section contains standard type LE refrigeration coils having three fins per inch and are equipped with special refrigerant distributor to insure uniform distribution of refrigerant. Heating coils available, if required, and can be easily mounted on brackets provided.
SIZES—Three sizes, 2½ to 15 tons of refrigeration, 3000 to 13,000 cfm.
MADE BY — *Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.*



Cast Iron Trap



NAME—No. 17-D radiator trap.
PURPOSE—To replace similar traps made of brass or other critical materials.
FEATURES — A new thermostatic radiator trap with gray cast iron body. The thermostatic element consists of four diaphragms of Adnic, a special alloy said to be corrosion-proof and free from any tendency to soften under high temperatures or to crack when subjected to repeated action. An important feature of the new trap is its renewable valve seat. Inlet connection, left hand thread; right hand thread available on special order only. Obtainable for any direct war work or for repair and maintenance under P-84 with an A-10 rating.
CAPACITIES—200 sq ft EDR.
MADE BY—*Hoffman Specialty Co., 1001 York Street, Indianapolis, Ind.*

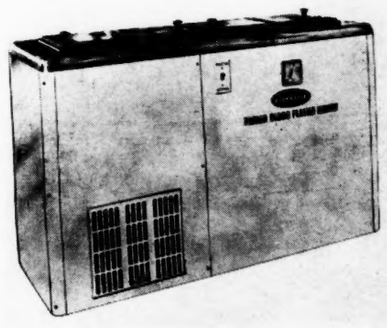


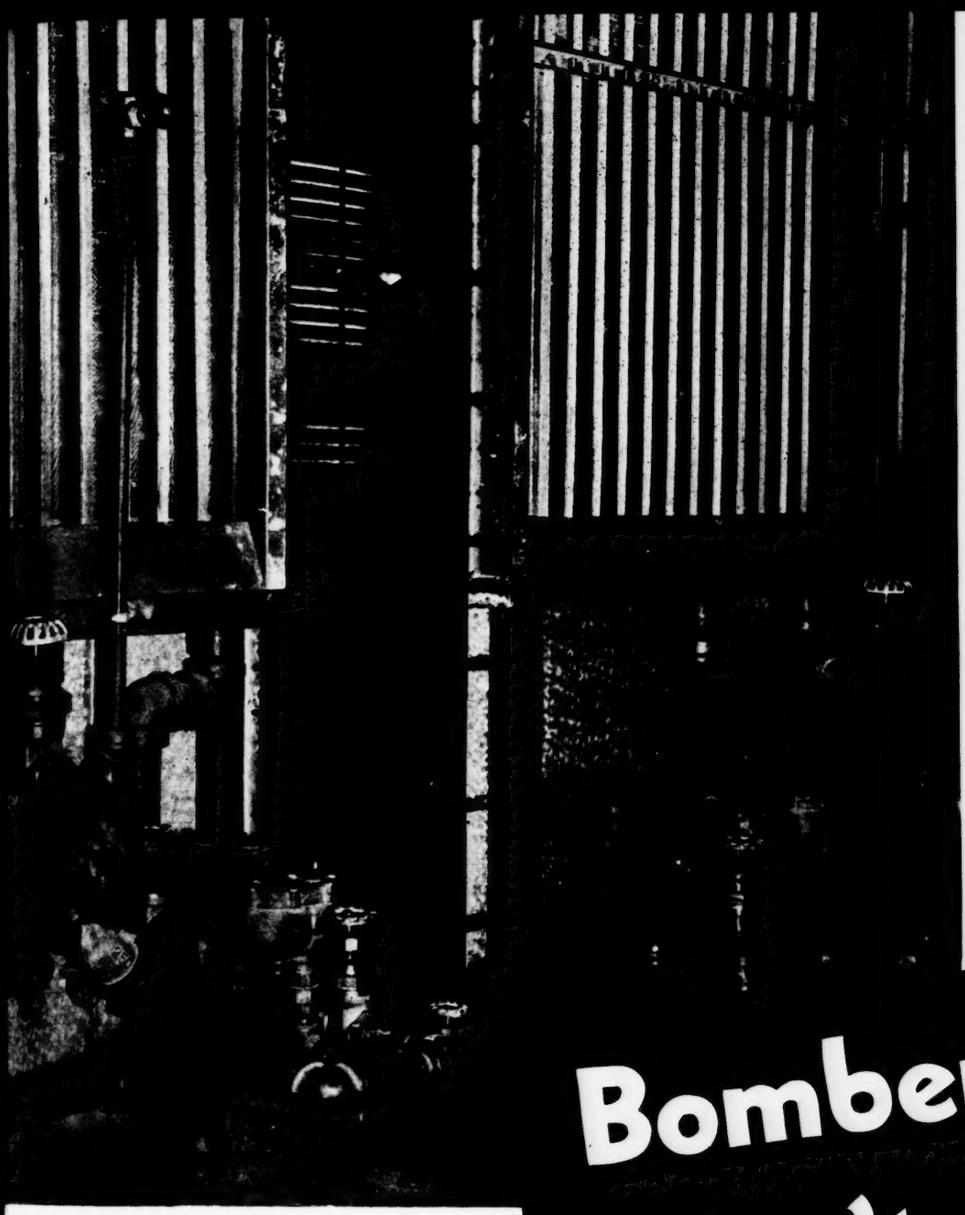
Variable Speed Drive

NAME—ALLSPEED Drive, model A.
PURPOSE—For variable control of the speed of driven loads.
FEATURES — This ball-bearing equipped drive is said to be especially compact, to be flexible enough to be applied to any type of machine within the power range, and so designed that it can be operated in any plane. Its multiple V-belt arrangement permits adjustment of driven speed over a range of 16 to 1, or the unit can be directly coupled to any standard motor and the output shaft run at motor speed. A springless mechanical positive belt-tensioning device automatically increases arc of belt contact when changing from low to high speeds. The drive need not be dismantled when changing belts.
SIZES—Model A in 1/3 to ¾ hp. Other models being built up to 10 hp.
MADE BY — *Worthington Pump & Machinery Corporation, Harrison, N. J.*

Blood Plasma Cabinet

NAME—Frozen blood plasma cabinet.
PURPOSE — For the freezing and storage of blood plasma.
SIZES — Capacities, 4¾, 9½, and 12¼ cu ft, respectively.
MADE BY — *Carrier Corporation, Syracuse, N. Y.*

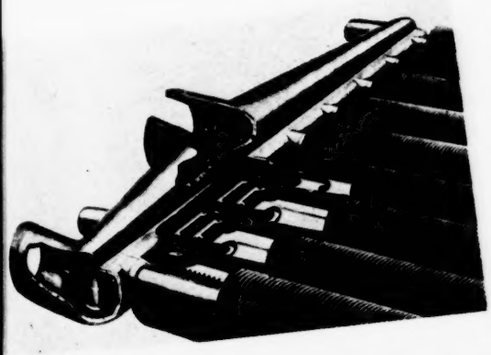




Bomber Plants Can't Afford Freeze-Ups!

Above: Aerofin Nonfreeze Coils in one of the main fan rooms of the Manufacturing Building of a large midwestern bomber plant.

Below: Cutaway view, showing features of Aerofin construction.

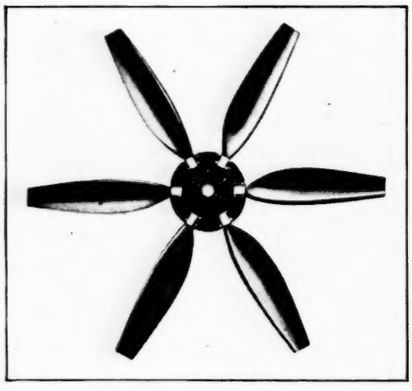


These Aerofin Nonfreeze Coils are installed in one of the main fan rooms of a large midwestern bomber plant, and there they guard against freeze-ups that might halt production of fighting planes. With these coils, complete steam modulation from zero up to full capacity can be attained and uniform heating is assured at every point. If your heating installation must give constant, uninterrupted performance, specify this new heating surface. No untried product, Aerofin Nonfreeze Coils are backed by the same guarantee given to all Aerofin products. Our nearest office can give you complete details.

AEROFIN CORPORATION

410 S. GEDDES ST., SYRACUSE, N. Y.

Chicago Detroit New York Philadelphia
Dallas Cleveland Toronto



Plastic Propeller Fan

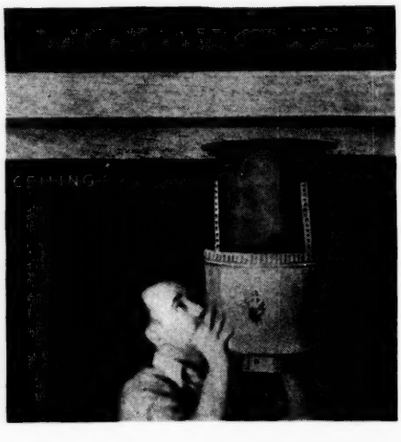
NAME—New Hartzite cooling tower fan.
PURPOSE — Supersedes aluminum-bladed fans.
FEATURES—Consists of a group of Hartzite plastic fan blades mounted on an all-steel hub. The hub-piece is made up of half-inch steel plate with a high carbon steel hub at the center, the plate being reinforced by welded gussets. Blades are attached by bearing-shaped clamps bolted to the plate at its outer edge. A recess in the blade shank fits into a raised band in the clamp, making a secure non-slip fastening. Pitch of blades adjusted by loosening clamp bolts, setting blade at desired angle, and reclamping. The plastic blade material is said to be highly resistant to moisture, corrosion, and abrasion. A fabric compounded with the plastic gives the plastic a multiple cross-grained structure which adds to the strength of the blades.
SIZES AND CAPACITIES—Made in three diameters of 10, 11 and 12 ft, respectively, in four or six bladed assemblies. Capacities from 71,900 cfm at ¼ in. static pressure with 5.80 brake horsepower to 197,000 cfm at 47.2 brake horsepower.
MADE BY—*Hartzell Propeller Fan Co., Div. of Castle Hills Corp., Piqua, O.*

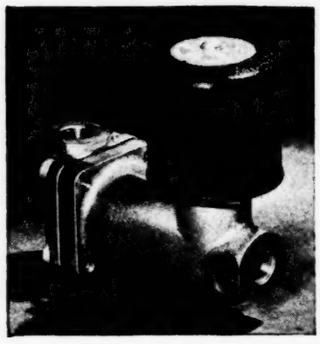
Plastic Pipe

NAME—Saran plastic pipe.
PURPOSE—To replace metal pipe.
FEATURES—Toughness, durability, and resistance to abrasion and corrosion are among the outstanding characteristics claimed for this new type of pipe. Made of Saran, a new thermoplastic resin, the pipe is said to have many adaptations in chemical processing plants; in oil, gas, and water company work; and in many general industrial applications. Conforms to extra heavy iron pipe dimensions and can be threaded with standard pipe threading tools, the only requirement being that sharp dies be used. Successful welds can be made simply by pressing exposed ends of the pipe against a plate heated to 350 to 400F, which melts the plastic and permits pushing the melted ends together until they cool and set. The initial set takes place within about 10 seconds, after which the welded section will stand ordinary handling; full strength after about 24 hours.
SIZES — Available in nominal pipe sizes of ½ to 2 in. Standard flanges available in same size range, other standard fittings available soon.
MADE BY—*The Dow Chemical Company, Midland, Mich.*

Chimney Support

NAME—Howle chimney support for vitroliner chimneys.
PURPOSE—For carrying the weight of vitroliner chimneys.
FEATURES — Consists of a deep metal collar with metal tie-straps, the collar fitting up against a shoulder on the bottom of the flue pipe. The stack is threaded up through holes in the ceiling and roof and the tie-straps bent over and nailed down to the top of the ceiling joists, thus forming a stable support for the portion of the chimney between the ceiling and the roof.
MADE BY—*Condensation Engineering Corp., 2515 Archer Avenue, Chicago, Ill.*





Three-Way Magnetic Valve

NAME—Series W-3-3, -4, -5 magnetic valves.
PURPOSE—For controlling the flow of oil, water, air, gas, steam, refrigerants, and similar fluids and vapors.
FEATURES—A single magnetic type of three-way valve, having ports in the top, bottom, and at one side. Internal mechanism and operation are such that when current is on, the bottom port is closed, leaving top and side port open for through flow. When current is off, top port is closed and the bottom and side ports are open for through flow. No intermediate positions are possible, according to the announcement. Reverse action can be secured simply by changing top and bottom connections. Valve can be used as a pilot valve controlling a large diaphragm regulating valve, or for the normal applications of three-way valves. Good for operating temperatures up to 400F.
SIZES AVAILABLE—Pipe sizes up to 1 in. and port sizes up to 15/32 in.
MADE BY — *General Controls Co., 801 Allen Avenue, Glendale, Calif.*

Moisture Absorber

NAME—Drier-Outer.
PURPOSE — For the absorption of atmospheric moisture and odors in homes.
FEATURES — Consists of a conveniently packaged odor and moisture absorbing chemical which can be placed in closets or other confined places as a drying and purifying agent. Air passing over the active chemicals in the top of the container gives up its odors and moisture. The moisture collects and drips into the bottom of the container. The chemical is said to be harmless to clothes, linens, and other household goods and the normal life of the unit to be about 30 days. Made in two sizes, one for closets, the other for basement use.
MADE BY—*Puritan Chemical Company, Atlanta, Georgia.*

DE-STA-CO
Blower Wheel Housings

of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.
Established Over 25 Years
375 Midland Ave • Detroit, Mich.

When you want accurate and dependable automatic temperature and humidity control for Air Conditioning Systems or Industrial Processes call in a Powers engineer. With a very complete line of self-operating and compressed air operated controls we are well equipped to fill your requirements.

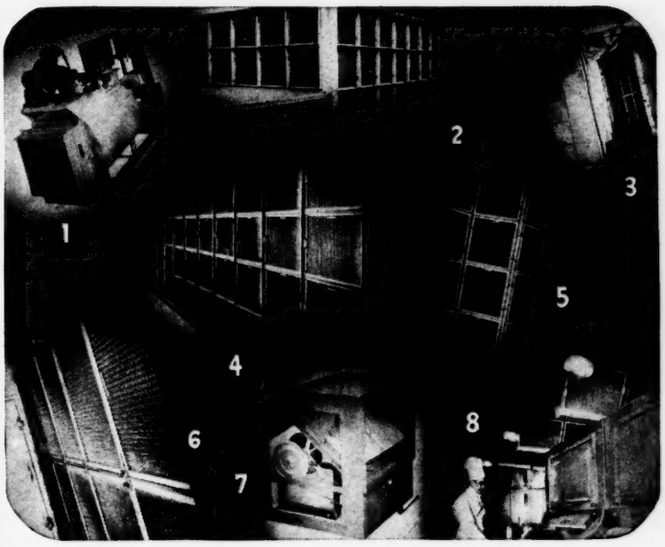
Write for Circular 2520

THE POWERS REGULATOR CO.
2759 Greenview Avenue, CHICAGO
Offices in 47 Cities—See your phone directory
50 Years of Temperature and Humidity Control

POWERS
★ TEMPERATURE AND HUMIDITY CONTROL ★

AIR-MAZE
PERMANENT PANELS

For Every Air Filter Application
Industrial • Commercial • Institutional



1. Well known industrial unit heater is AIR-MAZE equipped.
2. Typical AIR-MAZE installation in Detroit industrial plant.
3. AIR-MAZE installation in mid-western department store.
4. Large Cleveland bank building uses AIR-MAZE Air Filters.
5. Famous air conditioned Toledo cafeteria is AIR-MAZE equipped.
6. AIR-MAZE installation in one of New York's largest hotels.
7. Cut-away view of modern blower unit with AIR-MAZE filters.
8. AIR-MAZE Greastop filter installation in kitchen canopy of Detroit restaurant.

★ ★ ★

● The result of nearly twenty years of specialized engineering experience, AIR-MAZE Permanent Air Filter Panels embody every characteristic essential to the successful solution of air filtering problems in every field—industrial, commercial, institutional, and residential. Their long-range economy, high efficiency, large dust holding capacity, low pressure drop, and ease of cleaning have all been proved by scientific test as well as actual use. In the wide range of more than 3,000 types and sizes, there is an AIR-MAZE Filter Panel for every application to meet your particular requirements. Write for details.

AIR-MAZE CORPORATION
5230 Harvard Ave., Cleveland, Ohio

TWO OF THE MANY AVAILABLE AIR-MAZE FILTER PANELS

AIR-MAZE "A" PANEL
A heavy duty type air filter of multiple graduated density for protecting Engines, Compressors, Blowers and Severe Service Air Conditioning Systems.

AIR-MAZE "KLEENFLO" PANEL
Provides the economical solution for lighter service air conditioning systems. Unit Air Conditioners, Room Coolers, Furnace Blower Cabinets and Window Ventilators.

AIR-MAZE
DEPENDABLE AIR FILTERS FOR EVERY APPLICATION

BUILDERS
ARCHITECTS
CONTRACTORS

THE NEW SAL-MO

Non-Metallic SUPPLY DUCT

Will Help Solve Your Metal Shortage Problems

This new non-metallic conduit saves metal in constructing supply and return duct lines for warm air heating, air conditioning and ventilating systems. It permits many installations that would otherwise be impossible because of the shortages in critical metals.

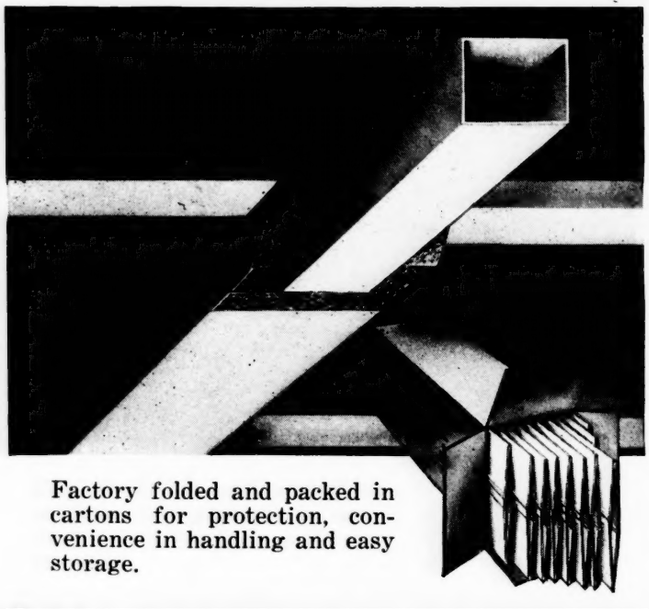
Sal-Mo Supply Duct assures a safe, insulated, fuel-saving duct system. It has been checked by leading independent laboratories and proved to possess a wide margin of safety.

Factory fabricated and packaged in cartons, there is no waste space in shipping and storing. It is most economical and convenient to handle.

S S D in sheets (Sal-Mo Supply Duct) is also available in flat sheets for the fabrication of ducts in your shop or on the job.

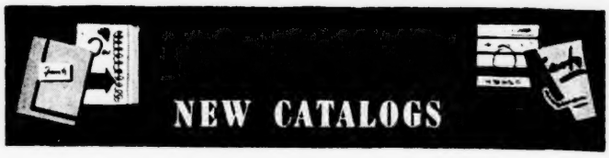
NO SHORTAGE—Sal-Mo Supply Duct is available in any quantity, and in a complete range of sizes for domestic and industrial requirements.

Investigate this New Duct Material—
See Your Jobber at Once or Write Us



Factory folded and packed in cartons for protection, convenience in handling and easy storage.

SALL MOUNTAIN COMPANY
176 W. Adams St., Dept. B, Chicago, Ill.



CONTROLS

Barber-Colman Company
Rockford, Illinois

Bulletin F-1756 lists the outstanding features of the company's compensated control system for zone temperature control work. Applications covered are for two pipe systems, vacuum, high or low pressure systems, or warm air systems, as used in conjunction with an oil burner, stoker, gas valve, or central station steam.

TRAPS

Armstrong Machine Works
Three Rivers, Michigan

A new eight-page standard size folder gives information and suggestions covering the war time conservation of steam traps. Includes installation and maintenance tips, lists of repair parts, and performance data.

AIR CLEANER

Westinghouse Electric & Mfg. Co. Dept. 7-N-20
East Pittsburgh, Pa.

A booklet, B-3083, 6 pages, describes the use of Precipitron, the electric air cleaner in war industry production. Several outstanding applications are illustrated together with a summary of the results and a description of how the apparatus operates.

BALANCING MACHINES

Bear Manufacturing Co., Industrial Division
Rock Island, Illinois

A new catalog describes the company's line of dynamic balancing machines for balancing armatures, fans, wheels, gears, and other rotating mechanisms.

MOTORS

Allis-Chalmers Mfg. Co.
Milwaukee, Wisconsin

Bulletin B-6052-C, 12 pages, standard size, lists the electrical and mechanical characteristics of squirrel cage, wound rotor, direct current and synchronous motors. Construction features, typical applications, dimension ratings, and price lists are included.

PIPING

The Grabler Manufacturing Company
6565 Broadway, Cleveland, Ohio

Blowups of the company's current advertising, which stresses the plumber's contribution to the war effort, are available for use as posters in shop windows or in other public places. These can be secured through plumbing supply jobbers or direct from the manufacturer.

VALVES

Crane Company
836 S. Michigan Avenue, Chicago, Ill.

A new 6-page standard size folder explains and illustrates the various steps followed in repairing leaky gate and globe valves and lists hints on how to reclaim discarded valves.

AIR FILTERS

Research Products Corporation
1015 E. Washington Ave., Madison, Wisconsin

A two-color, 4-page mailing folder which outlines the company's new "Sell-A-Box" sales plan. Its purpose is to suggest ways by which dealers can increase their sales of renewable filters and capitalize on the need for maintenance in heating equipment.

HEATING ACCESSORIES

Gorton Heating Corporation
Cranford, N. J.

Standard size, 4-page, two-color bulletin No. 112, gives descriptive matter and illustrations covering equalizing valves and air eliminators. List prices included.

CAST IRON UNIT HEATERS

D. J. Murray Mfg. Co.
Wausau, Wisconsin

An 8-page, standard size bulletin No. C1-42, gives ratings, dimensions, and other installation information for the company's new cast iron lines of Grid unit heaters.

CONTROLS

The Foxboro Company
Foxboro, Mass.

Catalog No. 95-A, consisting of 48 pages in ten sections, is described by the company as the most comprehensive bulletin it has ever issued on its full line of instruments for the measurement and control of industrial process conditions. Contains over 200 illustrations.

OVERHEAD AIR DIFFUSERS

Barber-Colman Company, Rockford, Illinois.

A standard size, 8-page catalog, F-1497-2 describing and illustrating the functions and construction of the Venturi-Flo overhead types of air diffusers.

WITH THE MANUFACTURERS

T. W. REYNOLDS

has been appointed Principal Materials Engineer of the Construction Div., Materials Control Branch, War Production Board, dealing with heating, ventilating, and air conditioning questions, and with offices in the Empire State Building, New York.

WHEELER INSTRUMENT CO.

has appointed C. L. Clark to its Cleveland office as sales engineer; Robert N. Miller, formerly sales and service engineer for Mercoid Corporation, now service engineer with the Wheelco Cleveland office; and Howard B. Jones, formerly with McGraw-Hill Publishing Co., has been employed as sales and service engineer at the Chicago office.

KEWANEE BOILER CORPORATION

was awarded the Army and Navy "E" pennant at ceremonies held at the company's plant August 25.

JENKINS BROS.

Bridgeport, Conn., has named Charles C. Chamberlain general sales manager. He has been publicity manager of the company since 1940. He will make his headquarters at the general offices of the company, 80 White Street, New York.

Are You Getting the Most Out of the AIR

Air is an economical, tireless worker. Today, when every minute counts, you can't stand for bottlenecks when air would help eliminate them.

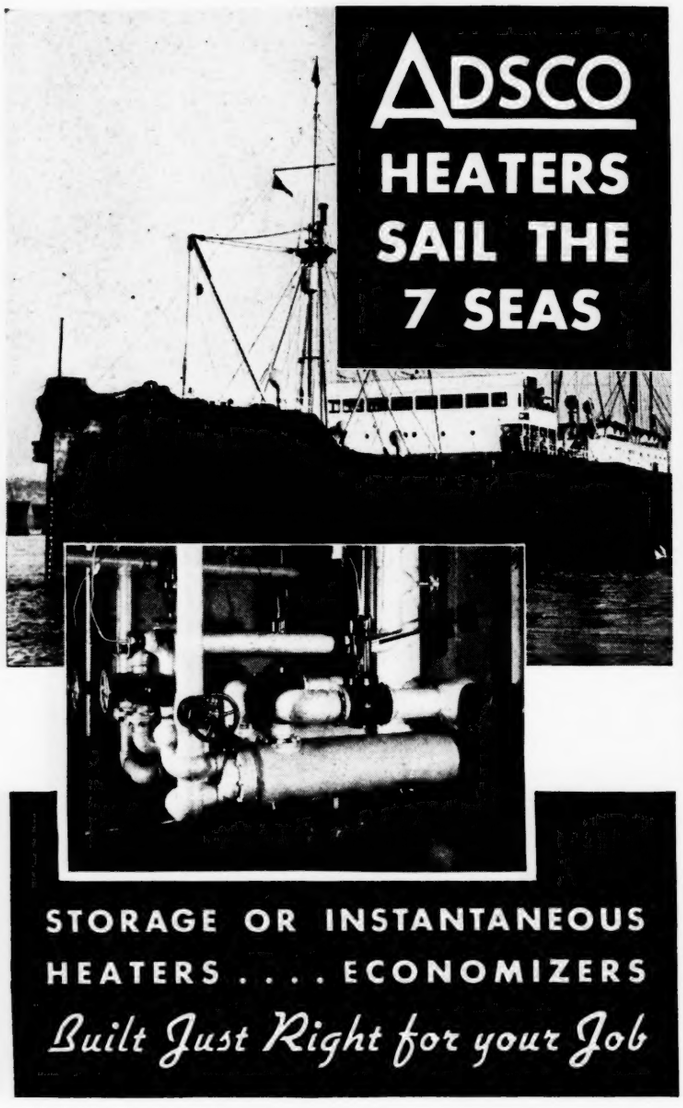
So, if you have a bottleneck in drying, processing, cooling, heating, conditioning—consider the use of air now. And let our staff of well-trained engineers help you get the most out of it with NEW YORK BLOWER air-moving equipment. There's a type for every industrial application.

- CENTRIFUGAL FANS AND BLOWERS
- JUNIOR CENTRIFUGAL BLOWERS
- DISC TYPE (or PROPELLER) PANEL FANS
- INDUSTRIAL UNIT HEATERS
- MECHANOVENT UNIT VENTILATORS
- AIR WASHERS
- HOT BLAST HEATING SURFACE
- MISCELLANEOUS

To holders of satisfactory priorities, the New York Blower Company is prepared to furnish the above equipment to take care of your air-moving problems.

Member: National Association of Fan Manufacturers and Industrial Unit Heater Associa

The NEW YORK BLOWER COMPANY
GENERAL OFFICES 32nd STREET & SHIELDS AVE., CHICAGO
FACTORIES AT LA PORTE, IND. and CHICAGO, ILL.



● America must deliver the goods—and hot water and steam are important requisites to the smooth running of big merchant ships. Here, as in America's large manufacturing plants, institutions, schools, colleges and public buildings, you will find ADSCO Heaters on the job in large numbers.

Whatever your particular water heating problem, ask ADSCO what type, size, capacity, pressure and construction will best meet your needs.

Avail yourself of ADSCO'S long years of experience building practically every size and type of heater—horizontal or vertical—storage or instantaneous—as well as heat economizers and special units to heat or cool oil, water or other liquids.

Get a heater that's built to meet your exact operating conditions. Submit the details—or write for illustrated Bulletins.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for over 60 years

SUMMER DEGREE HOURS (Above 85F) AUGUST, 1942

City	Number of Degree-Hours August, 1942	Number of Degree-Hours Summer, 1942 to August 31
Baltimore	238	1175
Birmingham	437	1906
Bismarck	146	216
Boston	62	259
Buffalo	0	12
Chicago	114	801
Cincinnati	93	675
Cleveland	10	444
Columbus	110	909
Des Moines	261	934
Detroit	23	441
Fort Wayne	0	444
Houston	666	2327
Indianapolis	140	1025
Memphis	553	3010
Milwaukee	43	305
Minneapolis	101	360
New Orleans	702	2165
New York	25	192
Oklahoma City	976	3064
Philadelphia	125	601
Pittsburgh	27	311
Portland, Ore.	271	859
Richmond, Va.	328	1727
St. Louis	391	1783
San Diego	0	2
San Francisco	0	9
Savannah	796	3177
Toledo	3	488
Washington	208	1223

These figures are computed from data made available through the cooperation of the U. S. Weather Bureau.

COMING EVENTS

OCTOBER 22.—Annual Meeting of the Plumbing & Heating Industries Bureau to be held at the Palmer House, Chicago, Ill. For further information write to the Bureau, 35 E. Wacker Drive, Chicago.

NOVEMBER 10-11.—Seventh Annual Meeting of the Industrial Hygiene Foundation, Mellon Institute, Pittsburgh, Pa. Further information from Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh, Pa.

NOVEMBER 24-29.—War-Time Chemical Show and Exposition, to be held at the Hotel Sherman, Chicago, Ill.. Further information from Marcus W. Hinson, manager of the exposition, National Chemical Exposition, 110 No. Franklin Street, Chicago, Illinois.

NOVEMBER 30-DECEMBER 4.—15th National Exposition of Power and Mechanical Engineering at the 1942 National Power Show to be held at Madison Square Garden, New York, N. Y. For further information write Charles F. Roth, manager of the exposition, 480 Lexington Avenue, New York, N. Y.

H&V's PHOTOS

Pages 25-33—Hedrich-Blessing Studio for Albert Kahn Associated Architects and Engineers, Inc.

Page 39—Office of War Information Photo.

Pages 43-46—Northwest Electric Company, Portland.

Page 48—Office of War Information Photo.

HEATING AND VENTILATING

THE AIR CONDITIONING MONTHLY